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METHOD FOR COMPUTATION OF STRUCTURAL FAILURE PROBABILITY FOR AN AIRCRAFT.

9 Final rept.,

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This report describes a procedure for computing the probability of aircraft failure of a given aircraft type as a function of flight time. Specifically, the single flight probability of failure, the aircraft probability of failure after a given number of flight hours and the expected number of aircraft losses are calculated. The approach is through fracture mechanics where the distribution of flaws in the structure is represented and combined with the probability of stress exceedance. The computation will allow for

structural inspections and rework. The listing of the computer routine and a sample problem to illustrate the method is included.

FORWARD

This report was prepared by John W. Lincoln, Structures Division of the Directorate of Flight Systems Engineering. The work was done as a research and development task to aid in the structural assessment of aircraft.

TABLE OF CONTENTS

SECTION I

INTRODUCTION

In many cases, it is helpful to calculate the failure probability for an aircraft in order to obtain a more quantified indication of the risk involved with a particular course of action. These types of calculations have proven useful in the past for helping managers to select from some difficult options.

The process defined in this report presumes that the analyst has the following:

(1) The probability density function for crack length for an area(s) of the aircraft that is to be analyzed.

(2) The probability density function for stress for the area(s) of the aircraft that is to be analyzed.

(3) The stress in the analysis area(s) at which a given crack size would be critical.

(4) The inspection reliability for inspections that are to be made.

(5) The structural rework to be performed (which consists of fastener hole reaming).

(6) The crack growth in the analysis area(s) as a function of time.

(7) The mission time for the desired sequence of flights.

This information is input to the computer routine as detailed in Section III. The output of the computation is the single flight probability of failure, the aircraft failure probability, and the expected number of failures in the force. The detailed equations for the computations are given in Section II.

Generally, the single flight probability of failure and the expected number of losses are the more useful outputs of this analysis. For an in-depth discussion of acceptable levels of safety, the reader is referred to Bo Lundberg's Wright Brothers Lecture on "Fatigue LIfe of Airplane Structures" published in the Journal of the Aeronautical Sciences, June, 1955. Lundberg provides some arguments for safety levels that could be used for commercial aircraft. The maximum allowable single flight probability of failure for a military aircraft is dependent on such factors as the mission of the aircraft, safety of the air crew, and feasibility of modifications and/or inspections to reduce the risk.

SECTION II

DEVELOPMENT OF RISK ANALYSIS METHODOLOGY

1 BASIC FUNCTION DEFINITIONS

Suppose that T is a positive number and that N_P is the number of control points on the airframe, N_M is the number of different missions flown, N_I is the number of inspections in the time interval [0,T], N_R is the number of structural reworks to be performed in the time interval [0,T], and each of b, c, d, and e is a positive integer such that b is in $[1,N_P]$, c is in $[1,N_M]$, d is in $[0,N_I]$, and e is in $[0,N_R]$. Further, suppose that p_C^{bde} is a simple surface such that the point $(x,t, p_C^{bde}(x,t))$ is a point of p_C^{bde} only if x is a positive number, t is a positive number $\leq$ T, and $p_C^{bde}(x,t)$ is the crack length probability density between the dth and d+1 inspection and between the eth and e+1 rework (note that when d = 0, the aircraft has not received an inspection and when e = 0 the aircraft has not been reworked) for the crack length x at the bth control point of the aircraft for the flight time t. p_C^{bde} is called the crack length probability density function corresponding to the bth control point, dth inspection, and eth rework.

Now, suppose that a^{bcde} is a simple graph such that the point $(t, a^{bcde}(t))$ is a point of a^{bcde} only if each of $a^{bcde}(o)$ and t is a positive number and $a^{bcde}(t)$ is the crack length at the time t (based on an initial crack of size $a^{bcde}(o)$) at the bth control point of an aircraft flying the cth mission at the time t after the dth inspection and eth rework. The simple graph a^{bcde} is called the crack growth function for the bth control point and the cth mission and for the dth inspection and eth rework.

Now, suppose that P_I^b is a simple graph such that the point $(x, P_I^b(x))$ belongs to P_I^b only if x is a positive number and $P_I^b(x)$ is the probability that a crack of length x will not be detected during an inspection of the bth control point. The simple graph P_I^b is called the inspection function for the bth control point.

Suppose that p_X^{bc} is a simple graph such that the point (x, p_S^{bc}(x)) belongs to p_S^{bc}(x) only if x is a number and p_S^{bc}(x) is the probability density of the bth control point for the maximum stress x in a single flight of the cth mission. p_S^{bc} is the stress probability density function for the bth control point of an aircraft flying the cth mission.

Next, suppose that S_c^b is a simple graph such that the point (x S_c^b(x)) belongs to S_c^b only if S_c^b is the stress at which a crack of length x at the bth control point becomes critical. S_c^b is the critical crack length function for the bth control point.

Now, suppose that N_F is a simple graph such that the point (t, N_F(t)) belongs to N_F only if t is in [0,T] and N_F(t) is the number of flights flown at the time t. N_F is called the flight number function.

Further, suppose that N_{MF} is a simple graph such that the point (F, N_{MF}(f)) belongs to N_{MF} only if f is a positive integer in the interval [1, N_F(T)] and N_{MF}(f) is the mission number flown on the flight numbered f. N_{MF} is called the mission number function.

Suppose that t_F is a simple graph such that the point (f,t_F(f) belongs to t_F only if g is an integer in [1,N_F(T)] and t_F(f) is the time just preceding the fth flight. t_F is called the flight time function.

Also, suppose that N_{PW} is a simple graph such that the point (b,N_{PW}(b)) belongs to N_{PW} only if b is in [1,N_P] and N_{PW}(b) is the number of points with the same p_C^{bde}, a^{bc}, P_I^b, p_S^{bc}, and S_c^b functions in the computation for the bth control point N_{PW} is the repeat control point function.

2 INFLUENCE OF INSPECTIONS ON THE CRACK PROBABILITY DENSITY FUNCTION

Suppose that a_I^b is a positive number such that following an inspection at the bth control point, the detected cracks are reworked such that they have crack sizes uniformly distributed in the interval $[0, a_I^b]$.

If the nth inspection at the bth control point is accomplished at the time t after the eth rework then the crack probability function for the crack length x changes from $p_C^{bne}(x,t)$ to $p_C^{bn+1e}(x,t)$.

Based on the definition of P_I^b, if x is in $[a_I^b, \infty]$ then $p_C^{bn+1e}(x,t) = p_C^{bne}(x,t) \cdot P_I^b(x)$ and if x is in $[0, a_I^b]$ then

$$p_C^{bn+1e}(x,t) = p_C^{bne}(x,t) \cdot P_I^b(x)$$

$$+ \frac{1 - \int_0^\infty p_C^{bne}(Ix,t)\, P_I^b(Ix)\, dIx}{a_I^b}$$

where the term

$$\frac{1 - \int_0^\infty p_C^{bne}(Ix,t) P_I^b(Ix)\, dIx}{a_I^b}$$

is the uniform probability distribution derived from the population of cracks found and repaired.

3 INFLUENCE OF STRUCTURAL REWORK ON THE CRACK PROBABILITY DENSITY FUNCTION

Suppose that each of a^b_{RRo} and a^b_{RR} is a positive number such that $o < a^b_{RR} \leq a^b_{RRo}$. The crack length probability density function corresponding to the bth control, dth inspection, and nth structural rework is modified by structural rework as follows: For each point (x,y) in the x-y projection of p^{bdn}_C such that if $x \geq a^b_{RRo}$ then x is replaced by $x-a^b_{RR}$. Therefore, if after this replacement

$$\gamma = \int_0^{a_{RRo}} p^{bdn}_C(a^b_{RRo},t)dIx$$

$$+ \int_{a_{RRo}}^{\infty} p^{bdn}_C(Ix,t)\, dIx$$

then,

$$p^{bdn+1}_C(x,t) = \frac{p^{bdn}_C(a_{RRo},t)}{\gamma} \quad \text{for } x < a^b_{RRo}$$

and

$$p^{bdn+1}_C(x,t) = \frac{p^{bdn}_C(x,t)}{\gamma} \quad \text{for } x \geq a^b_{RRo}\ ,$$

It is noted that the new distribution is uniform between 0 and a^b_{RRo}

At a given time the single flight probability of failure can be computed as follows: If it is assumed that at a given time the aircraft crack distribution function is statistically independent of the stress density function for a particular control point then if t is in [0,T], b is in $[1,N_P]$, c is in $[1,N_M]$, is in $[1,N_I]$, e is in $[1,N_R]$, s is in the x-projection of p_S^{bc}, x is in the x-projection of p_C^{bde} then there is a number

$$p_J^{bdce}(x,s,t) = p_C^{bde}(x,t) \cdot p_S^{bc}(s)$$

which is the joint probability density of crack length and stress for the point (x,s,t). Since this product exists for each number in [0,T], in the x-projection of p_C^{bde} and in the x-projection of p_S^{bc} then a simple surface p_J^{bcde} called the joint probability density function of crack length and stress is defined.

It follows then that if R^b is a point set such that ordered pair (x,s) is a member of R^b only if the crack length is critical for the stress s (defined by the simple graph S_c^b) then the probability of failure at the bth control point at the time t during one flight of the cth mission is

$$p_F^{bcde}(t) = \iint_{R^b} p_J^{bcde}[Ix,Is,t]dIxdIs$$

The probability that there will be no failure at the time t for a single flight of the cth mission is $(1-p_F^{bcde}(t))$. Therefore, for all control points identical to the bth, the single flight probability of failure is

$$p_{FW}^{bcde}(t) = 1 - \prod_{1}^{N_{PW}(b)} (1-p_F^{bcde}(t))$$

and for the aircraft the single flight probability of failure is

$$p_{FWA}^{cde} = 1 - \prod_{b=1}^{b=N_P} (1-p_{FW}^{bcde}(t))$$

From this function, if N_A is the number of aircraft in the population then the expected number of failures in the population at the time t is

$$E_{FWA}^{de}(t) = N_A(1-\prod_{f=1}^{N_F(t)} (1-p_{FWA}(t_F(f)))^{N_{MF}(f)de})$$

SECTION III

DESCRIPTION OF COMPUTER PROGRAM

1 NOTATION

The notation for input data to the routine is given later in this section and is not repeated here.

TF Table - a set of numbers used for single linear interpolation to determine the flight time corresponding to the number of missions flown by the aircraft. The maximum number of points allowed in the TF Table is 100.

PCB Table - a set of numbers that contains points of the crack length probability density function for interpolation in the PCBM Table. The maximum number of points allowed in the PCB Table is 51.

PI Table - a set of numbers used for single linear interpolation to determine the probability of not detecting a crack of a given size during an inspection. The maximum number of points allowed in the PI Table is 100.

SCB Table - a set of numbers used for single linear interpolation to determine the stress at which a given crack size will be critical. The maximum number of points allowed in the SCB Table is 100.

PCBM Table - a set of numbers computed from the PCB Table used for single linear interpolation to determine the crack length probability density function for a given crack size. The PCBM Table is modified by the routine to account for crack length change.

PDSBC Table - a set of numbers used for double linear interpolation to determine the stress probability density function for a given stress. Total number of PDSBC Table entries allowed is 1000. Maximum number of stress entries per mission is 50.

AB Table - a set of numbers used for double linear interpolation to determine the crack length for a given mission and time. Used to calculate the incremental crack growth for flight of a given mission(s). Total number of AB Table entries allowed is 1000. Maximum number of crack length entries is 100.

CRACKL(I) - The Ith crack length entry in the PCBM Table.

PCBT(I) - The Ith crack probability density entry in the PCBM Table.

NCRL - The number of crack length entries in the PCBM Table.

DAREAP(I) - Trapezoidal rule approximation to the area

$$\int_{CRACKL(I)}^{CRACKL(I+1)} p_C^{bde}(Ix,0)dIx$$

PSIL(I) - The Ith stress entry in the PDSBC Table.

PDPSI(I) - The Ith stress probability density function entry in the PDSBC Table.

NPSIL - The number of stress entries in the PDSBC Table.

TIMCLC(I) - The time derived from the TF Table corresponding to the number of flights NFLTS(I).

PFBCT(KT) - Probability of failure during one flight at the KTth risk calculation (including inspections and reworks) for a single control point.

PFBC = PFBCT(KT) for a given KT

TIMI(JINSP) - The time derived from the TF Table corresponding to the number of flights NIN(JINSP).

TIMR(JREWK) - The time derived from the TF Table corresponding to the number of flights NRE(JREWK).

TIME(KT) - The time corresponding to the KTth risk calculation (including inspections and reworks).

DELTM - The incremental time between risk calculation points.

TB - The time derived from the AB Table corresponding to a specified crack length and mission. The crack length is an entry in the PCBM Table.

DLAREA - Integration step size for calculation of single flight probability of failure.

PFT(I) - The single flight probability of failure for the aircraft at the Ith risk calculation point.

PF(I) - The probability of failure for the aircraft for the time defined by the Ith risk calculation point.

PFF(I) - The expected number of failures in a force of size NA corresponding to the Ith risk calculation point.

2 COMPUTATION OF AIRCRAFT FAILURE PROBABILITY

The subroutine FINCLC computes the aircraft failure probability as follows: Suppose that

I is an integer

PFT(I) is the single flight probability of failure at the Ith calculation step

PF(I) is the airplane probability of failure at the Ith calculation step

RNF_I is the number of flights between the I-1st and Ith calculation steps

Suppose further that the single flight probability of failure for the RJth flight after the I-1st calculation step can be expressed by

$$PFT_I(J) = PFT(I-1) + \left(\frac{PFT(I) - PFT(I-1)}{RNF_I}\right) RJ$$

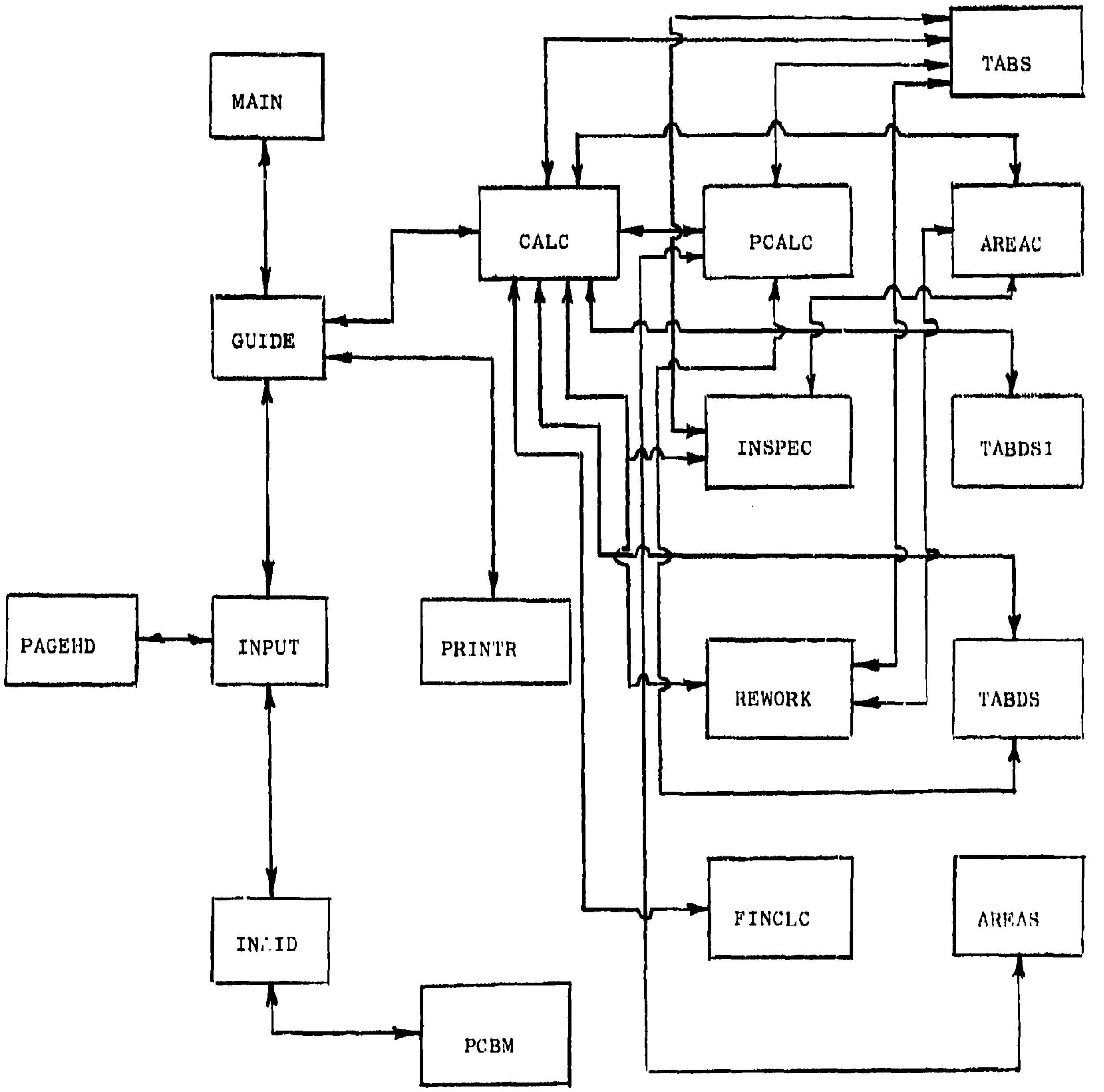
Consequently, the airplane failure probability at the Ith calculation step is

$$PF(I) = 1.0 - \prod_{RJ=1}^{RNF_I} \left(1 - \left(PFT(I-1) + \left(\frac{PFT(I) - PFT(I-1)}{RNF_I}\right) RJ\right)\right)$$

3 COMPUTER FLOW DIAGRAM AND PROGRAM

The computer routine was coded in FORTRAN Extended Language with the main program and subroutines arranged as follows:

RISKY Program (See Appendix A)



MAIN - Main Program - Sets NZERO to zero and transfers program control to GUIDE.

GUIDE - Subroutine - Initially zeros input and output numbers. GUIDE is the primary controlling subroutine that for each of NP control points on the structure transfers control to INPUT, CALC, and PRINTR.

INPUT - Subroutine - Reads in all input data. A procedure for reading in the required input data is given later in the section.

INAID - Subroutine - Called by INPUT and has the purpose of writing out certain input data. INAID also sets NZERO = 1 for control of data handling in GUIDE.

PCBM - Subroutine - Called by INAID to modify the PCB table and create the PCBM table. If there are n points in the PCB table and if x_1, x_2 ''', x_n are the abscissas and y_1, y_2, ''', yn are the ordinates of the points of the PCB table then x_1, x_2, $1.000001x_2$, x_3, $1.000001x_3$, ''', $1.000001x_{n-1}$, x_n are the abscissas and y_1, y_2, y_2, y_3, y_3, '''y_{n-1}, y_n are the ordinates of the points of the PCBM table.

PAGEHD - Subroutine - Writes out page heading including run identification, date and page number.

CALC - Subroutine - Performs the following functions:

(1) Computes flight times for failure probability calculation.

(2) Corrects the crack length probability density function for error in area.

(3) Identifies the mission being flown.

(4) Checks for end of computer run.

(5) Checks for inspection requirement before next flight.

(6) Checks for rework requirement before the next flight.

(7) Establishes new crack probability density function for next failure probability calculation.

PCALC - Subroutine - Integrates the joint probability density function p_J^{bcde} to obtain p_F^{bcde}.

INSPEC - Subroutine - This subroutine is called when an inspection is to be performed. INSPEC computes the new crack length probability density function after an inspection. Also, it corrects the crack length probability density function for error in area. It is assumed that the cracks found by inspection are repaired.

REWORK - Subroutine - This subroutine is called when a structural rework is to be performed. REWORK computes the new crack length density function after the rework has been performed. Also, it corrects the crack length probability density function for error in area. The rework performed is independent of crack size. The crack population is diminished by the number $a_{RR}^b \leq a_{RRo}^b$.

FINCLC - Subroutine - Called by CALC to perform the following functions:

(1) Computes the single flight probability of failure for the aircraft.

(2) Computes the probability of failure for the aircraft.

(3) Computes the expected number of failures in the population.

TABS - Subroutine - Used for straight line interpolation in a single table look-up.

TABDS - Subroutine - Used for straight line interpolation in a double table look-up. Suppose each of S_x, S_y, and S_z is a number set such that if (x,y,z) is a point of the double table then x belongs to S_x, y belongs to S_y and z belongs to S_z. Further, suppose that S_{xy} is a point set in a plane such that if x belongs to S_x and y belongs to S_y then (x,y) belongs to S_{xy}. The interpolation is on S_z for a point $(\bar{x},\bar{y})$ that is in the plane that contains S_{xy}.

TABDSI - Subroutine - Used for inverse interpolation of in a double table look-up (see TABDS). Suppose that S_{yz} is a point set in a plane such that if y belongs to S_y and z belongs to S_z then (y,z) belongs to S_{yz}. If y is in S_y and z is a number then the interpolation is on S_x for a point $(y,\bar{z})$ that is in the plane that contains S_{yz}.

AREAC - Subroutine - Computes area under a simple graph based on the trapazoidal rule. Maximum number of points from simple graph is 100.

AREAS - Subroutine - Computes area under a simple graph based on the trapazoidal rule. Maximum number of points from simple graph is 50.

PRINTR - Subroutine - Called from GUIDE to print the computed results at the conclusion of the run.

4 INPUT DATA

All of the input data described below is read into the program by means of the subroutine INPUT. This program is a general purpose routine to read the P (parameters), N (integers), and the tables. There are several options by which this may be done by this routine. A suggested arrangement is given as follows:

14I5 Format

IDENT	1	0	NPF3	0	NTI1	NTW1	MONTH	DAY	YEAR	NTI2	NTW2	NA	NCONTP

8I5 Format

NP	NTMS	NINSP	NREWK	NMISS	NLEN	NJST	NPRNT

72H

Run Description

72H

Run Description

3I5 Format

1	6	1

6E10.3 Format

DELCRK	DELST	TIMAX	AI	ARR	ARRO

If NTW1 = 0 go to (b); if NTW1 $>$ 0 go to (a)

Integer Set 1

(a)

3I5 Format

51	55	1

5I5 Format

NWT1(1) through NWT1(5)

(b) If NTW2 = 0 go to (d); if NTW2 $>$ 0 go to (c)

Integer Set 2

(c)

3I5 Format

57	58	1

2I5 Format

NWT2(1) through NWT2(2)

(d) If NCONTP $<$ NP go to (f)

If NCONTP = NP go to (e)

(e) Integer Set 3

3I5 Format

75	74 + NP	1

NP $\leq$ 15

12I5 Format

NPW(1) through NPW(NP)

(f) Integer Set 4

315 Format

101	100 + NTMS	1	NTMS $\leq$ 400

1215 Format

NFLTS(1) through NFLTS(NTMS)

Integer Set 5

315 Format

501	500 + NTMS	1	NTMS $\leq$ 400

1215 Format

MISS(1) through MISS(NTMS)

If NINSP = 0 go to (h)

If NINSP > 0 go to (g)

(g) Integer Set 6

315 Format

901	900 + NINSP	1	NINSP $\leq$ 20

1215 Format

NIN(1) through NIN(NINSP)

(h) If NREWK = 0 go to (j)

If NREWK > 0 go to (i)

(i) Integer Set 7

3I5 Format			
921	920 + NREWK	1	NREWK $\leq$ 20

12I5 Format

NRE(1) through NRE(NREWK)

(j) If NTI1 = 0 go to (l)

If NTI1 > 0 go to (k)

and read in NTI1 of the following single tables:

(k) TF Table

I 5, I15 Format

1	NSTAB1	NSTAB1 $\leq$ 100

6E10.3 Format

TABLI (1,1) through TABLI(NSTAB1,1) (flight number entries)

6E10.3 Format

TABLI(NSTAB1+1,1) through TABLI(2NSTAB1,1) (time entries)

PCB Table

I5,I15 Format

2	NSTAB2

NSTAB2 ≤ 51 - NINSP

6E10.3 Format

TABLI (1,2) through TABLI (NSTAB2,2)
(crack length entries)

6E10.3 Format

TABLI (NSTAB2+1,2) through TABLI (2NSTAB2,2)
(crack probability density entries)

PI Table

I5,I15 Format

3	NSTAB3

NSTAB3 ≤ 100

6E10.3 Format

TABLI(1,3) throught TABLI (NSTAB3,3)
(crack length entries)

6E10.3 Format

TABLI (NSTAB3+1,3) through TABLI (2NSTAB3,3)
(inspection probability entries)

SCB Table

I5,I15 Format

4	NSTAB4

NSTAB4 ≤ 100

6E10.3 Format

TABLI(1,4) through TABLI (NSTAB4,4)
(crack length entries)

6E10.3 Format

TABLI (NSTAB4+1,4) through TABLI (2NSTAB4,4)
(critical stress entries)

(1) If NTI2 = 0 go to (n)

If NTI2 $>$ 0 go to (m) and read in NTI2 of the following double tables:

(m) PDSBC Table

I5,I15,I10 Format

1	NDTAB11	NDTAB12

NDTAB11 $\leq$ 50
NDTAB12 $\leq$ 400
2NDTAB11 $\cdot$ NDTAB12 $\leq$ 1000

6E10.3 Format

TABL2(1,1) through TABL2 (NDTAB11,1)
(stress entries)

6E10.3 Format

TABL2 (NDTAB11+1,1) through TABL2 (NDTAB11 + NDTAB12,1)
(mission type entries)

6E10.3 Format

TABL2 (NDTAB11 + NDTAB12+1,1) through
TABL2 (NDTAB11 + NDTAB12 + NDTAB11 $\cdot$ NDTAB12)
(stress probability density entries)

AB Table

I5,I15,I10 Format

2	NDTAB21	NDTAB22

NDTAB21 $\leq$ 100
NDTAB22 $\leq$ 400
2NDTAB21 $\cdot$ NDTAB22 $\leq$ 1000

6E10.3 Format

TABL2(1,2) through TABL2 (NDTAB21,1)
(time entries)

6E10.3 Format

TABL2 (NDTAB21+1,2) through TABL2 (NDTAB21+NDTAB22,2)
(mission type entries)

6E10.3 Format

TABL2 (NDTAB21+NDTAB22+1,2) through
TABL2 (NDTAB21+NDTAB22+NDATB21 $\cdot$ NDTAB22)
(crack size entries)

(n) End of file.

The first card contains 14 fixed point (integer) numbers arranged in I5 fields. These 14 entries in order on this card are:

(1) IDENT - Run number

(2) 1

(3) 0

(4) NPF3 - Number of integer sets to be read in - maximum number = 7

(5) 0

(6) NTI1 - Number of single tables to be read in - maximum number = 4

(7) NTW1 = 1 if single tables are to be printed
= 0 otherwise

(8) Month - Month in date for page heading

(9) Day - Day in date for page heading

(10) Year - Year in date for page heading

(11) NTI2 - Number of double tables to be read in - maximum number = 2

(12) NTW2 = 1 if double tables are to be printed
=0 otherwise

(13) NA - Number of aircraft in the population

(14) NCONTP - Control point number for this run

The second card contains eight fixed point (integer) numbers arranged in I5 fields. In order these entries are:

(1) NP - Number of control points on aircraft for analysis - maximum number = 15

(2) NTMS - Number of times the risk is calculated in the run excluding the inspection and rework period

(3) NINSP - Number of inspections for this run

(4) NREWK - Number of reworks for this run

(5) NMISS - Number of different missions flown during this run

(6) NLEN - Number of crack lengths used in failure probability calculation

(7) NJST - Number of stresses used in failure probability calculation

(8) NPRNT = 1 if crack length history is to be printed
= 0 otherwise

The third and fourth cards each contain a 72H field for purpose of run descriptions, etc.

The fifth card contains 1, 6, and 1 in I5 fields

The sixth card contains six floating point number arranged in E10.3 fields. These six numbers are placed in the following order:

(1) DELCRK - The crack length interval for integration of the joint probability density function p_J^{bcde}

(2) DELST - The stress interval for integration of the joint probability density function p_J^{bcde}

(3) TIMAX - The flight time from zero at the end of the run

(4) AI - a_I^b

(5) ARR - a_{RR}^b

(6) ARRO - a_{RRO}^b

The next cards read in the Integer Sets as required.

Integer Set 1 -

First card contains 51, 55, and 1 in I5 fields

Second card contains NWT1(1) through NWT1(5) in I5 fields

NWT1(i) = 1 if the ith single table is to be printed

NWT1(i) = 0 otherwise

Integer Set 2 -

First card contains 57, 58, and 1 in I5 fields

Second card contains NWT2(1) and NWT2(2) in I5 fields where

NWT2(i) = 1 if the ith double table is to be printed

NWT1(i) = 0 otherwise

Integer Set 3 -

First card contains 75, 74 + NP, and 1 in I5 fields

The next card(s) contain NPW(1) through NPW(NP) in I5 fields

12 entries per card where NPW(b) = $N_{PW}(b)$

Integer Set 4 -
First card contains 101, 100 + NTMS, and 1 in I5 fields
The next card(s) contain NFLTS(1) through NFLTS(NTMS) in I5 fields
12 entries per card where NFLTS(i) is the number of flights at
the ith risk calculation (excluding inspections and reworks) in
the run

Integer Set 5 -
First card contains 501, 500 + NTMS, and 1 in I5 fields
The next card(s) contain MISS(1) through MISS(NTMS) in I5 fields
12 entries per card where MISS(i) is the mission type flown on the
flights $>$ NFLTS(i) and $\leq$ NFLTS (i+1)

Integer Set 6 -
First card contains 901, 900 + NINSP, and 1 in I5 fields
The next card(s) contain(s) NIN(1) through NIN(NINSP) in I5 fields
12 entries per card where NIN(i) is the number of flights just
preceeding the ith inspection.

Integer Set 7 -
First card contains 921, 920 + NREWK, and 1 in I5 fields
The next card(s) contain(s) NRE(1) through NIN(NREWK) in I5 fields
12 entries per card where NRE(i) is the number of flights just
preceeding the ith rework
The next cards read in the single tables as required.

TF Table -
First card contains 1 and NSTAB1 in an I5 and I15 field respectively
where NSTAB1 is the number of points in the TF table.
The next card(s) contain(s) the flight number entries in E10.3 fields
six to the card
The next card(s) contain(s) the times corresponding to the flight number
entries in E10.3 fields six to the card

PCB Table -

First card contains 2 and NSTAB2 in an I5 and I15 field respectively where NSTAB2 is the number of points in the PCB table. Note that if the PCB table is derived by taking n points from the function p_C^{bde} then the PCB table contains n points

The next card(s) contain(s) the crack length entries in E10.3 fields six entries to the card. If $x_1, x_2, \ldots, x_n$ are abscissas of the points taken from p_C^{bde} (arranged such that xi + 1 > xi) then the crack length entries are $x_1, x_2, \ldots, x_n$.

The next cards contain the ordinates from the p_C^{bde} function in E10.3 fields six entries to the card. These entries are ordered as follows: $p_C^{bde}(x_1), p_C^{bde}(x_2), \ldots, p_C^{bde}(x_n)$

PI Table -

First card contains 3 and NSTAB3 in an I5 and I15 field respectively where NSTAB3 is the number of points in the PI table and also is the number of points taken from the p_I^b function.

The next card(s) contain the abscissas of the points taken from p_I^b arranged such that $x_{i+1} > x_i$. These numbers are input in E10.3 fields six entries to the card.

The next card(s) contain(s) the ordinates of the p_I^b points corresponding to the abscissas entries above. The ordinates are entered in E10.3 fields six entries per card.

SCB Table -

First card contains 4 and NSTAB4 in an I5 and I15 field respectively where NSTAB4 is the number of points in the SCB table and also is the number of points taken from the s_C^b function.

The next card(s) contain(s) the abscissas of the points taken from s_C^b arranged such that $x_{i+1} > x_i$. These numbers are input in E10.3 fields six entries to the card.

The next card(s) contain(s) the ordinates of the s_c^b points corresponding to the abscissa entries above. The ordinates are entered in E10.3 fields six entries to the card.

PCBM Table -

The PCBM table is derived within the Subroutine PCBM from the PCB table. If there are n points in the PCB table, then there are 2n-2 points in the PCBM table. The first point of PCBM is the same as the first point PCB. If $1 < i < n$ then; the abscissa of the 2i-2 point of PCBM is the same as the abscissa of ith point of PCB, the abscissa of the 2i-1 point of PCBM is the abscissa of ith point of PCB x 1.000001, and the ordinate of the 2i-2 and the 2i-1 point of PCBM is the ordinate of the ith point of PCB. The last point of PCBM is the same as the last point of PCB.

PDSBC Table -

First card contains 1, NDTAB11, NDTAB12 in an I5, I15, and I10 field respectively where NDTAB11 is the number of stress entries in the table and NDTAB12 is the number of different missions entered in the table which is taken from the p_S^{bc} function.

The next card(s) contain(s) the stress entries x_1, $x_2, \cdots$ $x_{NDTAB11}$ arranged such that $x_{i+1} > x_i$. These numbers are input in E10.3 fields six entries to the card.

The next card(s) contain(s) the mission number entries y_1, $y_2, \cdots$, $y_{NDTAB12}$ arranged such that $y_{i+1} > y_i$. These numbers are input in E10.3 fields six entries to the card.

The next cards contain the ordinates of the p_S^{bc} function arranged so they correspond to the points (x_1,y_1), (x_2,y_1), $\cdots$, $(x_{NDTAB11},y_1)$, (x_1,y_2), $\cdots$, $(x_{NDTAB11}, y_{NDTAB12})$ from the entries above. These NDTAB11 · NDTAB12 numbers are input in E10.3 fields six entries to the card.

AB Table -

First card contains 2, NDTAB21, NDTAB22 in an I5, I15 and I10 field respectively where NDTAB21 is the number of time entries in the table and NDTAB22 is the number of different missions entered in the table.

The next card(s) contain the time entries x_1,x_2, $\cdots$, $x_{NDTAB21}$ arranged such that $x_{i+1} > x_i$. These numbers are input in E10.3 fields six entries to the card.

The next card(s) contain(s) the mission number entries y_1, y_2, ..., $y_{NDTAB22}$ arranged such that $y_{i-1} > y_i$. These numbers are input in E10.3 fields six entries to the card.

The next card(s) contain(s) the crack lengths arranged so that they correspond to the pair (x_1, y_1), ''', $(x_{NDTAB21}, y_1)$, (x_1, y_2), ''', $(x_{NDTAB21}, y_{NDTAB22})$. These NDTAB21 · NDTAB22 numbers are input in E10.3 fields six entries to the card.

5 EQUIVALENCE TABLES

The technique that has been used in coding this routine is to place all input and output numbers in blank common. All input and output floating point numbers are called parameters and are contained in P (dimensioned 9000). All input and output fixed point numbers are called integers and are contained in N (dimensioned 1500). To make the program more easily read, EQUIVALENCE statements are used to give the P and N number more recognizable names. The RISKY program parameter and integer tables are given below. Also given below is a brief description of the tables used for interpolation.

Integer Equivalence Table

N	Dimension	Term	N	Dimension	Term
1	(1)	IDENT	51	(5)	NWT1(1)
2	(1)	NPF1	55		NWT1(5)
3	(1)	NPF2	57	(2)	NWT2(1)
4	(1)	NPF3	58		NWT2(3)
5	(1)	NPF4			
6	(1)	NTI1	61	(5)	NTB1(1)
7	(1)	NTW1	65		NTB1(5)
8	(1)	MONTH	69	(2)	NTB12(1)
9	(1)	DAY	70		NTB12(3)
10	(1)	YEAR	72	(2)	NTB22(1)
11	(1)	NTI2	73		NTB22(3)
12	(1)	NTW2	75	(15)	NPW(1)
13	(1)	NA	89		NPW(15)
14	(1)	NCONTP			
15	(1)	NP			
16	(1)	NTMS	101	(400)	NFLTS(1)
17	(1)	NINSP	500		NFLTS(400)
18	(1)	NREWK	501	(400)	MISS(1)
19	(1)	NMISS	900		MISS(400)
20	(1)	NLEN	901	(20)	NIN(1)
21	(1)	NJST	920		NIN(20)
22	(1)	NPRNT	921	(20)	NRE(1)
			940		NRE(20)
			961	(400)	NUMF(1)
			1360		NUMF(400)
43	(1)	JINSP			
44	(1)	JREWK			
45	(1)	KT			
46					
47	(1)	NPSIL			
48	(1)	NZERO			
49	(1)	NPAGE			
50	(1)	NDCLC			

Parameter Equivalence Table

P	Dimension	Term	P	Dimension	Term
1	(1)	DELCRK	101	(50)	PSIL(1)
2	(1)	DELST	150		PSIL(50)
3	(1)	TIMAX	151	(400)	PFBCT(1)
4	(1)	AI	550		PFBCT(400)
5	(1)	ARR	551	(400)	TIMCLC(1)
6	(1)	ARRO	950		TIMCLC(400)
			951	(20)	TIMI(1)
			970		TIMI(20)
			971	(20)	TIMR(1)
			990		TIMR(20)
			991	(100)	PCBT(1)
			1090		PCBT(100)
			1091	(100)	CRACKL(1)
			1190		CRACKL(100)
			1191	(400)	TIME(1)
			1590		TIME(400)
			1591	(400,15)	PFBT(1,1)
			7590		PFBT(400,15)
			7591	(400)	PFT(1)
			7990		PFT(400)
			7991	(400)	PF(1)
			8390		PF(400)
			8391	(400)	PFF(1)
			8790		PFF(400)
			8791	(100)	DAREAP(1)
			8890		DAREAP(100)
50	(1)	RMISS			
51	(1)	PFBC			
52	(1)	DLAREA			

Interpolation Table Listing

Table	Dimension	Name	Description
TABL1(1,1) TABL1(200,1)	(200)	TF	Flight time vs number of flights
TABL1(1,2) TABL1(200,2)	(200)	PCB	Crack length probability density function vs crack length
TABL1(1,3) TABL1(200,3)	(200)	PI	Inspection function vs crack length
TABL1(1,4) TABL1(200,4)	(200)	SCB	Critical crack length function vs crack length
TABL1(1,5) TABL1(200,5)	(200)	PCBM	Modified PCB Table
TABL2(1.1) TABL2(1000,1)	(1000)	PDSBC	Stress probability density function vs stress and mission type
TABL2(1,2) TABL2(1000,2)	(1000)	AB	Crack size vs time and mission type

6 SAMPLE PROBLEM

The following sample problem is presented to acquaint the user with the input data and the output to be expected. The problem has a single inspection at 2200 flights and a structural rework at 2500 flights. The input cards are as follows:

```
207  1  0  7  0  4  1  8  15  1979  2  1  120  1
  1 30  1  1  1 50 65  0

RISK ANALYSIS FOR SEVERE TRAINING INCLUDES INSPECT AND REWORK
SINGLE 0.871 HOUR MISSION CRACK SIZE IN INCHES
  1  6  1
0.005  500.0  2265.0  0.050  0.030  0.040
 51 55  1
1 1  1  1  1
 57 58  1
1 1
 75 75  1
320
101  130  1
0  100  200  300  400  500  600  700  800  900  1000  1100
1200 1300 1400 1500 1600 1700 1800 1900 2000 2100  2200  2300
2400 2500 2600 2700 2800 2900
501  530  1
1  1  1  1  1  1  1  1  1  1  1  1
1  1  1  1  1  1  1  1  1  1  1  1
1  1  1     1  1  1
901  902  1
2200  3000
921  922  1
2500  3000
1  2
0.0  100.0
0.0  87.1
2  35
```

```
 0.0000316  0.0000398  0.0000501  0.0000631  0.0000794 0.0001000
 0.0001259  0.0001585  0.0001995  0.0002512  0.0003162  0.0003981
 0.0005012  0.0005310  0.0007943  0.001000   0.0012589  0.0015949
 0.0019952  0.0025119  0.0031623  0.0039811  0.0050119  0.0063096
 0.0079433  0.0100000  0.0125893  0.0158489  0.0199526  0.0251189
 0.0316228  0.0398107  0.0501107  0.0630957  0.0794328
 0.010[illegible]   0.0649     0.351      1.622      6.385      21.405
61.154     148.888    308.86     546.00     822.51     1055.85
1154.99    1076.62    855.19     578.86     333.89     164.11
68.737     24.533     7.462      1.934      0.4271     0.08037
 0.01289    0.001762   0.0002051  0.2035-04  0.1722-05  0.1241-06
 0.7618-08  0.3986-09  0.1777-10  0.0        0.0

 3          14
 0.00       0.01       0.02       0.03       0.04       0.05
 0.06       0.07       0.08       0.09       0.10       0.11
 0.12       0.14
 1.00       0.96       0.85       0.52       0.36       0.25
 0.19       0.15       0.11       0.08       0.06       0.05
 0.04       0.04

 4          23
 0.001      0.004      0.005      0.010      0.015      0.020
 0.030      0.040      0.050      0.080      0.100      0.110
 0.120      0.140      0.160      0.180      0.200      0.202
 0.204      0.206      0.208      0.210      1.00
200000.0   103000.0   95000.0    92000.0    75000.0    70000.0
62000.0    57000.0    56000.0    61000.0    63000.0    70000.0
66000.0    53000.0    43000.0    33000.0    25000.0    24000.0
22900.0    21300.0    20000.0    0.0        0.0
```

```
   1            28          1

15000.0    15700.0    20000.0    20500.0    21000.0    21500.0
22000.0    22500.0    23000.0    23500.0    24000.0    24500.0
25000.0    25500.0    26000.0    26500.0    27000.0    27500.0
28000.0    28500.0    29000.0    29500.0    30000.0    30500.0
31000.0    31500.0    32000.0    32500.0
    1.0
    0.0         0.0       807.2-06   487.8-06   365.9-06   243.9-06
  130.66-06   95.82-06   34.84-06   40.08-06   33.10-06   13.94-06
   12.18-06    8.72-06   15.68-06   11.84-06    8.36-06    6.80-06
    2.96-06    2.28-06    1.38-06    0.878-06   0.664-06   0.348-06
    0.262-06   0.140-06   0.112-06   0.088-06
   2           16           1
    0.0     10000.0    12000.0    14000.0    14500.0    15000.0
15500.0    16000.0    16500.0    17000.0    17125.0    17250.0
17375.0    17400.0    17450.0    18000.0
    1.0
    0.0001     0.0010     0.0015     0.0025     0.0030     0.0060
    0.0140     0.0260     0.0520     0.0860     0.0960     0.1110
    0.1280     0.1500     0.200      0.205
```

Based on this input the following output data was obtained.

```
RUN NO   207          DATE   8/15/1979          PAGE NO     1
RISK ANALYSIS FOR SEVERE TRAINING  INCLUDES INSPECT AND REWORK
SINGLE 2.871 HOUR MISSION    CRACK SIZE IN INCHES

INPUT DATA FOR RISK ANALYSIS

NUMBER OF AIRCRAFT IN FLEET      =    120
CONTROL POINT NUMBER             =      1
TOTAL NUMBER OF CONTROL POINTS   =      1
NUMBER OF FLT INCR IN ANALYSIS   =     30
NUMBER OF INSPEC. IN ANALYSIS    =      1
NUMBER OF REWORKS IN ANALYSIS    =      1
NUMBER OF DIFF MISSIONS IN ANAL  =      1
NUMBER OF CRACKS IN PROB CALC    =     50
NUMBER OF STRESSES IN PROB CALC  =     65

DELTA CRACK LENGTH IN PROB CALC       =   .0250
DELTA STRESS IN PROB CALC             =   500.0
ANALYSIS TIME INTERVAL                =  2265.0
MAX CRACK AFTER INSPEC AND FIX (AI)   =   .0500
CRACK REDUCTION AFTER REWORK (ARR)    =   .3300
REFERENCE CRACK AFTER REWORK (ARRO)   =   .0400

CONTROL POINT WEIGHTING FACTORS
  320

NUMBER OF FLIGHTS AT CALCULATION POINTS
     0   100   200   300   400   500   600   700   800   900  1000  1100  1200  1300  1400  1500  1600  1700  1800  1900
  2000  2100  2200  2300  2400  2500  2600  2700  2800  2900

MISSION NUMBER AT CALCULATION POINTS
     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1     1
     1     1     1     1     1     1     1     1     1     1

NUMBER OF FLIGHTS AT INSPECTION POINTS
  2200

NUMBER OF FLIGHTS AT REWORK POINTS
  2500
```

RUN NO 207 DATE 8/15/1979 PAGE NO 2

SINGLE TABLE NUMBER 1
TIME VS NUMBER OF FLIGHTS

NUMBER OF FLIGHTS

0.	1.4300E+02

TIME

0.	8.7100E+01

SINGLE TABLE NUMBER 2
CRACK DENSITY FUNCTION VS CRACK SIZE

CRACK SIZE

3.1680E-05	3.9880E-05	5.0160E-05	6.3170E-05	7.9450E-05	1.0370E-04	1.2590E-04	1.5850E-04	1.9950E-04	2.5120E-04
3.1623E-04	3.9810E-04	5.0120E-04	6.3100E-04	7.9430E-04	1.0000E-03	1.2589E-03	1.5949E-03	1.9952E-03	2.5119E-03
3.1623E-03	3.9811E-03	5.0119E-03	6.3096E-03	7.9433E-03	1.0000E-02	1.2589E-02	1.5849E-02	1.9953E-02	2.5119E-02
3.1623E-02	3.9811E-02	5.0119E-02	6.3096E-02	7.9433E-02					

CRACK DENSITY FUNCTION

1.0280E-02	6.4970E-02	3.5150E-01	1.6220E+00	6.3852E+00	2.1405E+01	6.1154E+01	1.4889E+02	3.0886E+02	5.4600E+02
8.2251E+02	1.0559E+03	1.1550E+03	1.0766E+03	8.5519E+02	5.7886E+02	3.3389E+02	1.6411E+02	6.8737E+01	2.4533E+01
7.4620E+00	1.9340E+00	4.2710E-01	8.0370E-02	1.2890E-02	1.7620E-03	2.0510E-04	2.0350E-05	1.7228E-06	1.2410E-07
7.6180E-09	3.9860E-10	1.7770E-11	0.	[illegible]					

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SINGLE TABLE NUMBER 3
INSPECTION RELIABILITY VS CRACK SIZE

CRACK SIZE

5.	1.0000E-02	2.0000E-02	3.0000E-02	4.0000E-02	5.0000E-02	6.0000E-02	7.0000E-02	8.0000E-02	9.0000E-02
1.0000E-01	1.1700E-01	1.2500E-01	1.4300E-01	1.6500E-01	2.0300E-01				

INSPECTION RELIABILITY

1.0000E+00	9.6000E-01	8.5000E-01	5.2900E-01	3.6600E-01	2.5300E-01	1.9000E-01	1.5000E-01	1.1000E-01	8.0300E-02
6.0000E-02	5.0300E-02	4.6000E-02	4.0030E-02	4.0000E-02	4.0300E-02				

SINGLE TABLE NUMBER 4
STRESS VS CRITICAL CRACK SIZE

CRITICAL CRACK SIZE

1.0000E-03	4.0300E-03	6.0400E-03	1.0000E-02	1.5000E-02	2.0300E-02	3.0000E-02	4.0000E-02	6.0000E-02	8.0000E-02
1.0000E-01	1.1000E-01	1.2000E-01	1.4000E-01	1.6000E-01	1.8000E-01	2.0000E-01	2.0200E-01	2.0400E-01	2.0600E-01
2.[illegible]000E-01	2.1000E-01	1.0000E+00							

STRESS

2.0000E+05	1.0300E+05	9.5000E+04	9.2300E+04	7.5000E+04	7.0300E+04	6.2000E+04	5.7000E+04	5.6000E+04	6.1000E+04
6.3900E+04	7.0300E+04	6.6000E+04	5.3000E+04	4.3000E+04	3.3100E+04	2.5000E+04	2.4000E+04	2.2900E+04	2.1300E+04
2.0000E+04	0.	0.							

SINGLE TABLE NUMBER 5
MODIFIED CRACK DENSITY FUNCTION VS CRACK SIZE

CRACK SIZE

3.1630E-05	3.9300E-05	3.9800E-05	5.0100E-05	5.0100E-05	6.3100E-05	6.3100E-05	7.9400E-05	7.9400E-05	1.0000E-04
1.0000E-04	1.2590E-04	1.2590E-04	1.5850E-04	1.5850E-04	1.9950E-04	1.9950E-04	2.5120E-04	2.5120E-04	3.1620E-04
3.1620E-04	3.9810E-04	3.9810E-04							

MODIFIED CRACK DENSITY FUNCTION

1.0220E-02	6.4970E-02	6.4970E-02	3.5100E-01	3.5100E-01	1.6220E+00	1.6220E+00	6.3850E+00	6.3850E+00	2.1405E+01
2.1405E+01	6.1154E+01	6.1154E+01	1.4889E+02	1.4889E+02	3.0886E+02	3.0886E+02	5.4600E+02	5.4600E+02	8.2251E+02
8.2251E+02	1.0559E+03	1.0559E+03	1.1550E+03	1.1550E+03	1.0766E+03	1.0766E+03	8.5519E+02	8.5519E+02	5.7886E+02
5.7886E+02	3.3339E+02	3.3309E+02	1.6411E+02	1.6411E+02	6.8737E+01	6.8737E+01	2.4533E+01	2.4533E+01	7.4620E+00
7.4620E+00	1.9340E+00	1.9340E+00	4.2710E-01	4.2710E-01	8.0370E-02	8.0370E-02	1.2890E-02	1.2890E-02	1.7620E-03
1.7620E-03	2.0510E-04	2.0510E-04	2.0350E-05	2.0350E-05	1.7220E-06	1.7220E-06	1.2410E-07	1.2410E-07	7.6180E-09
7.6180E-09	3.9860E-10	3.9860E-10	1.7770E-11	1.7770E-11	0.	0.	0.		

RUN NO 237 DATE 8/15/1979 PAGE NO 4

DOUBLE TABLE NUMBER 1
STRESS PROBILITY DENSITY FUNCTION VS
STRESS AND MISSION NUMBER

STRESS

1.5000E+04	1.9700E+04	2.[illegible]E+04	2.0500E+04	2.1000E+04	2.1500E+04	2.2850E+04	2.2530E+04	2.3000E+04	2.3500E+04
2.4000E+04	2.4500E+04	2.5[illegible]E+04	2.5500E+04	2.6900E+04	2.6500E+04	2.7000E+04	2.7500E+04	2.8000E+04	2.8500E+04
2.95[illegible]E+04	2.9500E+04	3.[illegible]E+04	3.[illegible]E+04	3.1[illegible]E+04	3.1500E+04	3.2000E+04	3.2500E+04		

MISSION NUMBER
1.0000E+00

STRESS PROBILITY DENSITY FUNCTION

0.	0.	8.[illegible]72[illegible]E-04	4.3700E-04	3.6590E-04	2.4390E-04	1.3066E-04	9.5820E-05	[illegible].4840E-05	4.[illegible]E-05
3.3190E-05	1.3940E-05	1.2180E-05	3.7200E-06	1.5680E-05	1.1840E-05	8.3600E-06	6.0000E-06	2.9600E-06	2.2800E-06
1.3800E-06	6.7840E-07	6.4400E-07	3.4830E-07	2.62[illegible]E-07	1.4800E-07	1.1200E-07	8.0000E-08		

RUN NO 287 DATE 8/15/1979 PAGE NO 5

DOUBLE TABLE NUMBER 2
CRACK GROWTH VS
TIME AND MISSION

TIME

0.	1.1000E+04	1.2000E+04	1.4000E+04	1.4500E+04	1.5100E+04	1.5500E+04	1.6000E+04	1.6500E+04	1.7000E+04
1.7125E+04	1.7250E+04	1.7375E+04	1.7450E+04	1.7455E+04	1.8000E+04				

MISSION NUMBER

1.0000E+00

CRACK GROWTH

1.0000E-04	1.0000E-03	1.5000E-03	2.5000E-03	3.0000E-03	6.9300E-03	1.4000E-02	2.6000E-02	5.2000E-02	8.6000E-02
9.6000E-02	1.1100E-01	1.2850E-01	1.5000E-01	2.0000E-01	2.0500E-01				

```
RUN NO   227            DATE   8/15/1979          PAGE NO     6
CRACK DENSITY AREA CALC. - TIME STEP =     1     AREA =  1.0132
STRESS DENSITY FUNCTION CALC. - AREA =  1.0822
CRACK DENSITY AREA CALC. - TIME STEP =     2     AREA =  1.0102
CRACK DENSITY AREA CALC. - TIME STEP =     3     AREA =  1.0132
CRACK DENSITY AREA CALC. - TIME STEP =     4     AREA =  1.0132
CRACK DENSITY AREA CALC. - TIME STEP =     5     AREA =  1.0132
CRACK DENSITY AREA CALC. - TIME STEP =     6     AREA =  1.0102
CRACK DENSITY AREA CALC. - TIME STEP =     7     AREA =  1.0102
CRACK DENSITY AREA CALC. - TIME STEP =     8     AREA =  1.0102
CRACK DENSITY AREA CALC. - TIME STEP =     9     AREA =  1.0132
CRACK DENSITY AREA CALC. - TIME STEP =    10     AREA =  1.0132
CRACK DENSITY AREA CALC. - TIME STEP =    11     AREA =  1.0182
CRACK DENSITY AREA CALC. - TIME STEP =    12     AREA =  1.0132
CRACK DENSITY AREA CALC. - TIME STEP =    13     AREA =  1.0102
CRACK DENSITY AREA CALC. - TIME STEP =    14     AREA =  1.0132
CRACK DENSITY AREA CALC. - TIME STEP =    15     AREA =  1.0132
CRACK DENSITY AREA CALC. - TIME STEP =    16     AREA =  1.0162
CRACK DENSITY AREA CALC. - TIME STEP =    17     AREA =  1.0132
CRACK DENSITY AREA CALC. - TIME STEP =    18     AREA =  1.0102
CRACK DENSITY AREA CALC. - TIME STEP =    19     AREA =  1.0192
CRACK DENSITY AREA CALC. - TIME STEP =    20     AREA =  1.0192
CRACK DENSITY AREA CALC. - TIME STEP =    21     AREA =  1.0152
CRACK DENSITY AREA CALC. - TIME STEP =    22     AREA =  1.0192
CRACK DENSITY AREA CALC. - TIME STEP =    23     AREA =  1.0102
CRACK DENSITY AREA CALC. - NO. OF PTS =    75     AREA =  .99992  INSPEC
CRACK DENSITY AREA CALC. - TIME STEP =    24     AREA =  1.0056
CRACK DENSITY AREA CALC. - TIME STEP =    25     AREA =  1.0030
CRACK DENSITY AREA CALC. - TIME STEP =    26     AREA =  1.0080
CRACK DENSITY AREA CALC. - NO. OF PTS =    32     AREA =  1.00000  REWORK
CRACK DENSITY AREA CALC. - TIME STEP =    27     AREA =  1.0035
CRACK DENSITY AREA CALC. - TIME STEP =    28     AREA =  1.0096
CRACK DENSITY AREA CALC. - TIME STEP =    29     AREA =  1.0096
CRACK DENSITY AREA CALC. - TIME STEP =    30     AREA =  1.0008
```

RUN NO 257 DATE 8/15/1979 PAGE NO 7

CONTROL POINT SINGLE FLIGHT FAILURE PROB.

NO	TIME	CP 1	CP 2	CP 3	CP 4	CP 5	CP 6	CP 7	CP 8	CP 9	CP10
1	0.	0.									
2	8.710E+01	0.									
3	1.742E+02	0.									
4	2.613E+02	0.									
5	3.484E+02	0.									
6	4.355E+02	0.									
7	5.226E+02	0.									
8	6.097E+02	0.									
9	6.968E+02	0.									
10	7.839E+02	3.382E-18									
11	8.710E+02	1.933E-17									
12	9.581E+02	1.596E-16									
13	1.045E+03	5.671E-16									
14	1.132E+03	1.559E-14									
15	1.219E+03	4.15[illegible]E-14									
16	1.307E+03	2.27[illegible]E-13									
17	1.394E+03	6.415E-13									
18	1.481E+03	5.878E-12									
19	1.568E+03	1.141E-11									
20	1.655E+03	6.437E-11									
21	1.742E+03	1.873E-10									
22	1.829E+03	5.675E-10									
23	1.916E+03	1.223E-09									
24	1.916E+03	4.891E-11									
25	2.[illegible]3E+03	1.744E-10									
26	2.09[illegible]E+03	5.[illegible]9E-10									
27	2.178E+03	1.657E-09									
28	2.178E+03	9.151E-20									
29	2.265E+03	3.258E-18									
30	2.352E+03	3.845E-18									
31	2.439E+03	4.705E-18									
32	2.526E+03	1.528E-09									

RUN NO 207 DATE 8/15/1979 PAGE NO 8

SINGLE FLIGHT FAILURE PROBABILITY
AIRCRAFT FAILURE PROBABILITY
EXPECTED FLEET FAILURES

NO	TIME	FLIGHTS	SINGLE	AIRCRAFT	FLEET
1	0.	0	0.	0.	0.
2	8.710E+01	100	0.	0.	0.
3	1.742E+02	200	0.	0.	0.
4	2.613E+02	300	0.	0.	0.
5	3.484E+02	400	0.	0.	0.
6	4.355E+02	500	0.	0.	0.
7	5.226E+02	600	0.	0.	0.
8	6.097E+02	700	0.	0.	0.
9	6.968E+02	800	0.	0.	0.
10	7.839E+02	900	2.274E-12	1.151E-10	1.381E-08
11	8.710E+02	1000	2.274E-12	3.425E-10	4.110E-08
12	9.581E+02	1100	2.274E-12	5.699E-10	6.838E-08
13	1.045E+03	1200	2.274E-12	7.972E-10	9.567E-08
14	1.132E+03	1300	6.821E-12	1.255E-09	1.505E-07
15	1.219E+03	1400	1.364E-11	2.281E-09	2.738E-07
16	1.307E+03	1500	7.276E-11	6.631E-09	7.958E-07
17	1.394E+03	1600	2.369E-10	2.068E-08	2.462E-06
18	1.481E+03	1700	2.819E-09	1.733E-07	2.080E-05
19	1.568E+03	1800	3.654E-09	4.974E-07	5.969E-05
20	1.655E+03	1900	2.150E-08	1.714E-06	2.056E-04
21	1.742E+03	2000	5.993E-08	5.755E-06	6.906E-04
22	1.829E+03	2100	1.316E-07	1.789E-05	2.147E-03
23	1.916E+03	2200	3.912E-07	4.664E-05	5.596E-03
24	1.916E+03	2200	1.565E-08	4.664E-05	5.596E-03
25	2.0[illegible]3E+03	2300	5.552E-08	5.023E-05	6.028E-03
26	2.090E+03	2400	1.699E-07	6.157E-05	7.389E-03
27	2.178E+03	2500	5.919E-07	9.987E-05	1.198E-02
28	2.178E+03	2500	2.274E-12	9.987E-05	1.198E-02
29	2.265E+03	2600	1.042E-07	1.051E-04	1.262E-02
30	2.352E+03	2700	1.230E-07	1.165E-04	1.398E-02
31	2.439E+03	2800	1.576E-07	1.302E-04	1.562E-02
32	2.526E+03	2900	4.890E-07	1.623E-04	1.948E-02

BASED ON 120 AIRCRAFT

APPENDIX - RISKY PROGRAM LISTTNG

The listing given below is a FORTRAN extended language routine. Section 3.3 gives the flow diagram for the various subroutines.

```
MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM
MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM
MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM
MMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMMM

          PROGRAM RISKY      74/74    OPT=1                        FTN 4.7+476        09/17/79  10.34.24        PAGE    1

                        PROGRAM RISKY (INPUT,OUTPUT,TAPE5=INPUT,TAPE6=OUTPUT)
                  C        MAIN PROGRAM                                                        MAIN  1
                  C        PROGRAM FOR COMPUTING THE EXPECTED NUMBER OF FAILURES IN            MAIN  2
                  C        AN AIRCRAFT FLEET                                                   MAIN  3
                              COMMON P(9000), N(1500), TABL1(200,5), TABL2(1000,2) MAIN  4
                              EQUIVALENCE (N(46), NZERO)                                       MAIN  5
                              NZERO = 0                                                        MAIN  6
                     10       CALL GUIDE                                                       MAIN  7
                              GO TO 10                                                         MAIN  8
                              END                                                              MAIN  9


      SYMBOLIC REFERENCE MAP (R=1)

  ENTRY POINTS
   4141  RISKY

  VARIABLES      SN  TYPE          RELOCATION
  21450  N           INTEGER   ARRAY    / /          21527  NZERO      INTEGER                / /
      0  P           REAL      ARRAY    / /          24404  TABL1      REAL         ARRAY     / /
  26354  TABL2       REAL      ARRAY    / /

  FILE NAMES         MODE
      0  INPUT                  2054  OUTPUT                     0  TAPE5                   2054  TAPE6

  EXTERNALS          TYPE   ARGS
        GUIDE                 0

  STATEMENT LABELS
   4143  10

  COMMON BLOCKS   LENGTH
        / /        13500

  STATISTICS
    PROGRAM LENGTH                  261B      177
    BUFFER LENGTH                 3664B      1972
    CM BLANK COMMON LENGTH       32274B     13500
           52000B CM USED
```

```
SUBROUTINE GUIDE       74/74    OPT=1                              FTN 4.7+476        09/17/79  18.34.24        PAGE     1

                                  SUBROUTINE GUIDE                                          GIDE  1
             C          SUBROUTINE FOR CALLING INPUT DATA AND CALCULATION ROUTINES          GIDE  2
                                  COMMON P(9000), N(1500), TABL1(200,5), TABL2(1000,2)      GIDE  3
                                  EQUIVALENCE (N(40), NZERO)                                GIDE  4
                                  EQUIVALENCE (N(15), NP)                                   GIDE  41
                                  IF (NZERO) 40, 10                                         GIDE  5
                     10           DO   20 I = 1, 9000                                       GIDE  6
                     20           P(I) = 0.0                                                GIDE  7
                                  DO   30 I = 1, 1500                                       GIDE  8
                     30           N(I) = 0                                                  GIDE  9
                     40           DO   50 I = 1, NP                                         GIDE  91
                                  CALL INPUT                                                GIDE 10
                                  CALL CALC                                                 GIDE 11
                                  CALL PRINTR                                               GIDE 12
                     50           CONTINUE                                                  GIDE 121
                                  RETURN                                                    GIDE 13
                                  END                                                       GIDE 14


     SYMBOLIC REFERENCE MAP (R=1)

ENTRY POINTS
    1  GUIDE

VARIABLES      SN  TYPE            RELOCATION
   26  I           INTEGER                              21450  N         INTEGER    ARRAY    / /
21466  NP          INTEGER                 / /          21527  NZERO     INTEGER             / /
    0  P           REAL        ARRAY       / /          24404  TABL1     REAL       ARRAY    / /
26354  TABL2       REAL        ARRAY       / /

EXTERNALS              TYPE    ARGS
       CALC                      0                            INPUT                0
       PRINTR                    0

STATEMENT LABELS
    0  10          INACTIVE                   0  20                                         0  30
   17  40                                     0  50

LOOPS  LABEL     INDEX      FROM-TO     LENGTH    PROPERTIES
    6  20        I            7  8         2B      INSTACK
   14  30        I            9 10         2B      INSTACK
   20  50      * I           11 15         6B                  EXT REFS

COMMON BLOCKS    LENGTH
       / /        13500

STATISTICS
  PROGRAM LENGTH                  27B       23
  CM BLANK COMMON LENGTH      32274B     13500
        52000B CM USED
```

```
                 SUBROUTINE INPUT                                      INPT   1
C          SUBROUTINE FOR INPUT OF FLOATING AND FIXED POINT NUMBERS   INPT   2
                 COMMON P(9000), N(1500), TABL1(200,5), TABL2(1000,2) INPT   3
                 INTEGER DAY, YEAR                                     INPT   4
                 DIMENSION NTB1(6), NTB12(3), NTB22(3)                 INPT   5
                 EQUIVALENCE (N(1), IDENT), (N(2), NPF1),              INPT   6
       1  (N(3), NPF2), (N(4), NPF3), (N(5), NPF4), (N(6), NTI1),      INPT   7
       2  (N(7), NTW1), (N(8), MONTH), (N(9), DAY), (N(10), YEAR),     INPT   8
       3  (N(11), NTI2), (N(12), NTW2), (N(13), NA), (N(14), NCONTP),  INPT   9
       4  (N(15), NP), (N(16), NTMS), (N(17), NINSP), (N(18), NREWK),  INPT  10
       5  (N(19), NMISS), (N(20), NLEN), (N(21), NJST), (N(22), NPRNT) INPT  11
                 EQUIVALENCE (N(61), NTB1), (N(69), NTB12),            INPT  12
       1  (N(72), NTB22)                                               INPT  13
                 EQUIVALENCE (N(43), NPAGE)                            INPT  14
C          INPUT DATA - CONTROL INTEGERS                               INPT  15
C          N(1) = IDENT - PROBLEM NUMBER                               INPT  16
C          N(2) = NPF1 - NUMBER OF SETS OF PARAMETERS TO BE READ       INPT  17
C                     BY FORMAT 1                                      INPT  18
C          N(3) = NPF2 - NUMBER OF PARAMETERS TO BE READ BY FORMAT 2   INPT  19
C          N(4) = NPF3 - NUMBER OF SETS OF INTEGERS TO BE READ         INPT  20
C                     BY FORMAT 3                                      INPT  21
C          N(5) = NPF4 - NUMBER OF INTEGERS TO BE READ BY FORMAT 4     INPT  22
C          N(6) = NTI1 - NUMBER OF SINGLE TABLES TO BE READ            INPT  23
C          N(7) = NTW1 = 1 IF SINGLE TABLES ARE TO BE PRINTED          INPT  24
C                 NTW1 = 2 IF NO SINGLE TABLES ARE TO BE PRINTED       INPT  25
C          N(8) = MONTH                                                INPT  26
C          N(9) = DAY                                                  INPT  27
C          N(10) = YEAR                                                INPT  28
C          N(11) = NTI2 = NUMBER OF DOUBLE TABLES TO BE READ           INPT  29
C          N(12) = NTW2 = 1 IF DOUBLE TABLE IS TO BE PRINTED           INPT  31
C                  NTW2 = 0 OTHERWISE                                  INPT  32
C          N(13) = NA - NUMBER OF AIRCRAFT IN THE POPULATION           INPT  33
C          N(14) = NCONTP - CONTROL POINT NUMBER FOR THIS RUN          INPT  34
C          N(15) = NP - TOTAL NUMBER OF CONTROL POINTS                 INPT  35
C          N(16) = NTMS - NUMBER OF TIMES RISK CALCULATED EXCLUDING    INPT  36
C                      CALCULATION AT INSPECTION AND REWORK PERIOD     INPT  37
C          N(17) = NINSP - NUMBER OF INSPECTIONS IN RISK ANALYSIS PERIOD INPT  38
C          N(18) = NREWK - NUMBER OF REWORKS IN RISK ANALYSIS PERIOD   INPT  39
C          N(19) = NMISS - NUMBER OF DIFFERENT MISSIONS FLOWN IN RISK  INPT  40
C                       ANALYSIS PERIOD                                INPT  41
C          N(20) = NLEN - NUMBER OF CRACK LENGTHS IN PROBABILITY CALC  INPT  42
C          N(21) = NJST - NUMBER OF STRESSES IN PROBABILITY CALC       INPT  43
C          N(22) = NPRNT = 1 IF CRACK LENGTH HISTORY IS TO BE PRINTED  INPT 431
C                  NPRNT = 0 OTHERWISE                                 INPT 432
C          SET PAGE NUMBER EQUAL TO ONE                                INPT  44
                 NPAGE = 1                                             INPT  45
C          READ CONTROL INTEGERS                                       INPT  46
                 READ (5,10) (N(I), I = 1, 22)                         INPT  47
   10      FORMAT (14I5)                                               INPT  48
                 CALL PAGEHD                                           INPT  49
C          READ AND WRITE MISCELLANEOUS RUN INFORMATION                INPT  50
                 READ (5,20)                                           INPT  51
   20      FORMAT (36H                                                 INPT  52
       1   , 36H                                                       INPT  53
       2   / 36H                                                       INPT  54
       3   , 36H                                                     ) INPT  55
                 WRITE (6,20)                                          INPT  56
```

```
      C     READ IN PARAMETERS BY FORMAT 1                           INPT 57
                      IF (NPF1) 30, 70                               INPT 58
         30           DO   60 I = 1, NPF1                            INPT 59
                      READ (5,40) NP11, NP22, NP33                   INPT 60
         40     FORMAT (3I5)                                         INPT 61
                      READ (5,50) (P(J), J = NP11, NP22, NP33)       INPT 62
         50     FORMAT (6E10.3)                                      INPT 63
         60           CONTINUE                                       INPT 64
      C     READ IN PARAMETERS BY FORMAT 2                           INPT 65
         70           IF (NPF2) 60, 110                              INPT 66
         80           DO  100 J = 1, NPF2                            INPT 67
                      READ (5,90) I, P(I)                            INPT 68
         90     FORMAT (I5, E15.7)                                   INPT 69
        100           CONTINUE                                       INPT 70
      C     READ IN INTEGERS BY FORMAT 3                             INPT 71
        110           IF (NPF3) 120, 160                             INPT 72
        120           DO  150 I = 1, NPF3                            INPT 73
                      READ (5,130) NNG11, NNG22, NNG33               INPT 74
        130     FORMAT (3I5)                                         INPT 75
                      READ (5,140) (N(J), J = NNG11, NNG22, NNG33)   INPT 76
        140     FORMAT (12I5)                                        INPT 77
        150           CONTINUE                                       INPT 78
      C     READ IN INTEGERS BY FORMAT 4                             INPT 79
        160           IF (NPF4) 170, 200                             INPT 80
        170           DO  190 J = 1, NPF4                            INPT 81
                      READ (5,180) I, N(I)                           INPT 82
        180     FORMAT (I5, I15)                                     INPT 83
        190           CONTINUE                                       INPT 84
      C     READ IN SINGLE TABLES                                    INPT 85
        200           IF (NTI1) 210, 230                             INPT 86
        210           DO  220 J = 1, NTI1                            INPT 87
                      READ (5,180) I, NTB1(I)                        INPT 88
                      NTAB = NTB1(I)                                 INPT 881
                      NTABP1 = NTAB + 1                              INPT 882
                      NTB = NTB1(I) * 2                              INPT 89
                      READ (5,50) (TABL1(K,I), K = 1, NTAB)          INPT 90
                      READ (5,50) (TABL1(K,I), K = NTABP1, NTB)      INPT 901
        220           CONTINUE                                       INPT 91
      C     READ IN DOUBLE TABLES                                    INPT 911
        230           IF (NTI2) 240, 260                             INPT 92
        240           DO  255 J = 1, NTI2                            INPT 921
                      READ (5,250) I, NTB12(I), NTB22(I)             INPT 93
        250     FORMAT (I5,I15,I10)                                  INPT 94
                      NTB12I = NTB12(I)                              INPT 941
                      NTP = NTB12(I) * NTB22(I)                      INPT 95
                      NTT1P1 = NTB12(I) + 1                          INPT 96
                      NNTT12 = NTB12(I) + NTB22(I)                   INPT 97
                      NN12P1 = NNTT12 + 1                            INPT 98
                      NF = NNTT12 + NTP                              INPT 99
                      READ (5,50) (TABL2(K,I), K = 1, NTB12I)        INPT100
                      READ (5,50) (TABL2(K,I), K = NTT1P1, NNTT12)   INPT101
                      READ (5,50) (TABL2(K,I), K = NN12P1, NF)       INPT102
        255           CONTINUE                                       INPT1021
        260           CALL INAID                                     INPT103
                      RETURN                                         INPT104
                      END                                            INPT105
```

```
                    SUBROUTINE INAID                                          INAD 1
        C     SUBROUTINE FOR PRINTING OF INPUT DATA                           INAD 2
                    COMMON P(9800), N(1500), TABL1(200,5), TABL2(1000,2)      INAD 3
                    DIMENSION NWT1(5), NTB1(5), NTB12(3), NTB22(3),           INAD 4
            1 NWT2(3), NPW(15), NFLTS(400), NIN(20), NRE(20), NTRE(20),       INAD 41
            2 MISS(400)                                                       INAD 42
                    EQUIVALENCE (P(1), DELCRK), (P(2), DELST),                INAD 5
            1 (P(3), TIMAX), (P(4), AI), (P(5), APR), (P(6), ARR0)            INAD 6
                    EQUIVALENCE (N(7), NTW1), (N(12), NTW2)                   INAD 7
                    EQUIVALENCE (N(13), NA), (N(14), NCONTP),                 INAD 8
            1 (N(15), NP), (N(16), NTMS), (N(17), NINSP), (N(18), NREWK),     INAD 9
            2 (N(19), NMISS), (N(20), NLEN), (N(21), NJST)                    INAD 10
                    EQUIVALENCE (N(49), NPAGE)                                INAD 101
                    EQUIVALENCE (N(61), NTB1), (N(69), NTB12),                INAD 11
            1 (N(72), NTB22)                                                  INAD 12
                    EQUIVALENCE (N(51), NWT1), (N(57), NWT2)                  INAD 121
                    EQUIVALENCE (N(75), NPW)                                  INAD 122
                    EQUIVALENCE (N(101), NFLTS), (N(501), MISS),              INAD 125
            1 (N(901), NIN), (N(921), NRE)                                    INAD 126
                    CALL PCBH                                                 INAD 127
                    WRITE (6,10)                                              INAD 13
         10   FORMAT (/10X, 28HINPUT DATA FOR RISK ANALYSIS)                  INAD 14
                    WRITE (6,20) NA, NCONTP, NP, NTMS, NINSP, NREWK,          INAD 15
            1 NMISS, NLEN, NJST                                               INAD 16
         20   FORMAT (/10X, 34HNUMBER OF AIRCRAFT IN FLEET      = , I5        INAD 17
            1        /10X, 34HCONTROL POINT NUMBER             = , I5         INAD 18
            2        /10X, 34HTOTAL NUMBER OF CONTROL POINTS   = , I5         INAD 19
            3        /10X, 34HNUMBER OF FLT INCR IN ANALYSIS   = , I5         INAD 20
            4        /10X, 34HNUMBER OF INSPEC. IN ANALYSIS    = , I5         INAD 21
            5        /10X, 34HNUMBER OF REWORKS IN ANALYSIS    = , I5         INAD 22
            6        /10X, 34HNUMBER OF DIFF MISSIONS IN ANAL  = , I5         INAD 23
            7        /10X, 34HNUMBER OF CRACKS IN PROB CALC    = , I5         INAD 231
            8        /10X, 34HNUMBER OF STRESSES IN PROB CALC  = , I5)        INAD 232
                    WRITE (6,30) DELCRK, DELST, TIMAX, AI,                    INAD 24
            1 ARR, ARR0                                                       INAD 241
         30   FORMAT (/10X, 37HDELTA CRACK LENGTH IN PROB CALC     =, F8.4    INAD 25
            1        /10X, 37HDELTA STRESS IN PROB CALC           =, F5.1     INAD 26
            2        /10X, 37HANALYSIS TIME INTERVAL              =, F8.1     INAD 27
            3        /10X, 37HMAX CRACK AFTER INSPEC AND FIX (AI) =, F8.4     INAD 28
            5        /10X, 37HCRACK REDUCTION AFTER REWORK (ARR)  =, F5.4,    INAD 282
            6        /10X, 37HREFERENCE CRACK AFTER REWORK (ARR0) =, F8.4 )   INAD 29
                    WRITE (6,32)                                              INAD 291
         32   FORMAT (/10X, 31HCONTROL POINT WEIGHTING FACTORS )              INAD 292
                    WRITE (6,34) (NPW(I), I = 1, NCONTP)                      INAD 293
         34   FORMAT (15I7)                                                   INAD 294
                    WRITE (6,35)                                              INAD 295
         35   FORMAT (/10X, 39HNUMBER OF FLIGHTS AT CALCULATION POINTS)       INAD 296
                    WRITE (6,36) (NFLTS(I), I = 1, NTMS)                      INAD 297
         36   FORMAT (20I6)                                                   INAD 298
                    WRITE (6,37)                                              INAD 299
         37   FORMAT (/10X, 36HMISSION NUMBER AT CALCULATION POINTS)          INAD 300
                    WRITE (6,36) (MISS(I), I = 1, NTMS)                       INAD 301
                    IF (NINSP) 371, 381                                       INAD 301
        371         WRITE (6,38)                                              INAD 302
         38   FORMAT (/10X, 38HNUMBER OF FLIGHTS AT INSPECTION POINTS)        INAD 303
                    WRITE (6,36) (NIN(I), I = 1, NINSP)                       INAD 304
        381         IF (NREWK) 382, 393                                       INAD 304
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  382        WRITE (6,39)                                                     INAD 305
   39  FORMAT (/10X, 34HNUMBER OF FLIGHTS AT REWORK POINTS)                   INAD 306
             WRITE (6,36) (NRE(I), I = 1, NREWK)                              INAD 307
  393        NPAGE = NPAGE + 1                                                INAD 311
             CALL PAGEHD                                                      INAD 312
             K = 1                                                            INAD 313
             IF (NTH1) 40, 300                                                INAD 314
   40        IF (NWT1(1)) 50, 80                                              INAD 32
   50        WRITE (6,60)                                                     INAD 33
   60  FORMAT (//10X, 21HSINGLE TABLE NUMBER 1                                INAD 34
     1        /10X, 26HTIME VS NUMBER OF FLIGHTS                              INAD 35
     2       //10X, 17HNUMBER OF FLIGHTS )                                    INAD 36
             NTT1 = NTB1(1)                                                   INAD 37
             WRITE (6,70) (TABL1(I,1), I = 1, NTT1)                           INAD 38
   70  FORMAT (1P10E12.4)                                                     INAD 39
             NTT1P1 = NTT1 + 1                                                INAD 40
             NF = 2 * NTT1                                                    INAD 41
             WRITE (6,75)                                                     INAD 42
   75  FORMAT (/ 10X,  4HTIME)                                                INAD 43
             WRITE (6,70) (TABL1(I,1), I = NTT1P1, NF)                        INAD 44
             K = K + 1                                                        INAD 45
   80        IF (NWT1(2)) 90, 120                                             INAD 46
   90        WRITE (6,100)                                                    INAD 47
  100  FORMAT (//10X, 21HSINGLE TABLE NUMBER 2                                INAD 48
     1        /10X, 36HCRACK DENSITY FUNCTION VS CRACK SIZE                   INAD 49
     2       //10X, 10HCRACK SIZE )                                           INAD 50
             NTT1 = NTB1(2)                                                   INAD 51
             WRITE (6,70) (TABL1(I,2), I = 1, NTT1)                           INAD 52
             NTT1P1 = NTT1 + 1                                                INAD 53
             NF = 2 * NTT1                                                    INAD 54
             WRITE (6,110)                                                    INAD 55
  110  FORMAT (/ 10X, 22HCRACK DENSITY FUNCTION )                             INAD 56
             WRITE (6,70) (TABL1(I,2), I = NTT1P1, NF)                        INAD 57
             K = K + 1                                                        INAD 58
             IF (K - 2) 120, 120, 115                                         INAD 581
  115        NPAGE = NPAGE + 1                                                INAD 582
             CALL PAGEHD                                                      INAD 583
             K = - 1                                                          INAD 584
  120        IF (NWT1(3)) 130, 180                                            INAD 59
  130        WRITE (6,140)                                                    INAD 60
  140  FORMAT (//10X, 21HSINGLE TABLE NUMBER 3                                INAD 61
     1        /10X, 36HINSPECTION RELIABILITY VS CRACK SIZE                   INAD 62
     2       //10X, 10HCRACK SIZE )                                           INAD 63
             NTT1 = NTB1(3)                                                   INAD 64
             WRITE (6,70) (TABL1(I,3), I = 1, NTT1)                           INAD 65
             NTT1P1 = NTT1 + 1                                                INAD 66
             NF = 2 * NTT1                                                    INAD 67
             WRITE (6,150)                                                    INAD 68
  150  FORMAT (/ 10X, 22HINSPECTION RELIABILITY)                              INAD 69
             WRITE (6,70) (TABL1(I,3), I = NTT1P1, NF)                        INAD 70
             K = K + 1                                                        INAD 71
             IF (K - 2) 170, 170, 160                                         INAD 72
  160        NPAGE = NPAGE + 1                                                INAD 73
             CALL PAGEHD                                                      INAD 74
             K = 0                                                            INAD 75
  170        IF (NWT1(4)) 180, 220                                            INAD 76
  180        WRITE (6,190)                                                    INAD 77
```

```
193    FORMAT (//10X, 21HSINGLE TABLE NUMBER 4                    INAD 78
     1          /10X, 29HSTRESS VS CRITICAL CRACK SIZE            INAD 79
     2         //10X, 19HCRITICAL CRACK SIZE )                    INAD 80
              NTT1 = NTB1(4)                                      INAD 81
              WRITE (6,70) (TABL1(I,4), I = 1, NTT1)              INAD 82
              NTT1P1 = NTT1 + 1                                   INAD 83
              NF = 2 * NTT1                                       INAD 84
              WRITE (6,200)                                       INAD 85
              WRITE (6,70) (TABL1(I,4), I = NTT1P1, NF)           INAD 87
200    FORMAT (/ 10X,  6HSTRESS)                                  INAD 86
              K = K +1                                            INAD 88
              IF (K - 2) 230, 230, 220                            INAD 89
210           NPAGE = NPAGE + 1                                   INAD 90
              CALL PAGEHD                                         INAD 91
              K = 0                                               INAD 92
220           IF (NWT1(5)) 230, 300                               INAD 93
230           WRITE (6,240)                                       INAD 94
240    FORMAT (//10X, 21HSINGLE TABLE NUMBER 5                    INAD 95
     1          /10X, 45HMODIFIED CRACK DENSITY FUNCTION VS CRACK SIZEINAD 96
     2         //10X, 10HCRACK SIZE )                             INAD 97
              WRITE (6,70) (TABL1(I,5), I = 1, NTT1)              INAD 99
              NTT1 = NTB1(5)                                      INAD 98
              NTT1P1 = NTT1 + 1                                   INAD100
              NF = 2 * NTT1                                       INAD101
              WRITE (6,250)                                       INAD102
250    FORMAT (/ 10X, 31HMODIFIED CRACK DENSITY FUNCTION )        INAD103
              WRITE (6,70) (TABL1(I,5), I = NTT1P1, NF)           INAD104
300           IF (NTW2) 310, 410                                  INAD122
310           IF (NWT2(1)) 315, 342                               INAD1221
315           NPAGE = NPAGE + 1                                   INAD123
              CALL PAGEHD                                         INAD124
              WRITE (6,320)                                       INAD125
320    FORMAT (//10X, 21HDOUBLE TABLE NUMBER 1                    INAD126
     1          /10X, 36HSTRESS PROBILITY DENSITY FUNCTION VS     INAD127
     2          /10X, 25HSTRESS AND MISSION NUMBER                INAD128
     3         //10X,  6HSTRESS)                                  INAD129
              NTP = NTB12(1) * NTB22(1)                           INAD130
              NTT1P1 = NTB12(1) + 1                               INAD131
              NNTT12 = NTB12(1) + NTB22(1)                        INAD132
              NF = NNTT12 + NTP                                   INAD134
              NN12P1 = NNTT12 + 1                                 INAD133
              NTB121 = NTB12(1)                                   INAD135
              WRITE (6,70) (TABL2(I,1), I = 1, NTB121)            INAD136
              WRITE (6,330)                                       INAD137
330    FORMAT (/ 10X, 14HMISSION NUMBER)                          INAD138
              WRITE (6,70) (TABL2(I,1), I = NTT1P1, NNTT12)       INAD139
              WRITE (6,340)                                       INAD140
340    FORMAT (/ 10X, 33HSTRESS PROBILITY DENSITY FUNCTION )      INAD141
              WRITE (6,70) (TABL2(I,1), I = NN12P1, NF)           INAD142
342           IF (NWT2(2)) 344, 410                               INAD1421
344           NPAGE = NPAGE + 1                                   INAD143
              CALL PAGEHD                                         INAD144
              WRITE (6,350)                                       INAD145
350    FORMAT (//10X, 21HDOUBLE TABLE NUMBER 2                    INAD146
     1          /10X, 15HCRACK GROWTH VS                          INAD147
     2          /10X, 16HTIME AND MISSION                         INAD148
     3         //10X,  4HTIME )                                   INAD149
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SUBROUTINE INAID       74/74    OPT=1                         FTN 4.7+476          09/17/79  10.34.24        PAGE     4

                                    NTP = NTB12(2) * NTB22(2)                                INAD150
                                    NTT1P1 = NTB12(2) + 1                                    INAD151
                                    NNTT12 = NTB12(2) + NTB22(2)                             INAD152
                                    NN12P1 = NNTT12 + 1                                      INAD153
                                    NF = NNTT12 + NTP                                        INAD154
                                    NTB122 = NTB12(2)                                        INAD155
                                    WRITE (6,70) (TABL2(I,2), I = 1, NTB122)                 INAD156
                                    WRITE (6,360)                                            INAD157
                    360      FORMAT (/ 10X, 14HMISSION NUMBER)                               INAD158
                                    WRITE (6,70) (TABL2(I,2), I = NTT1P1, NNTT12)            INAD159
                                    WRITE (6,370)                                            INAD160
                    370      FORMAT (/ 10X, 12HCRACK GROWTH)                                 INAD161
                                    WRITE (6,70) (TABL2(I,2), I = NN12P1, NF)                INAD162
                    410             NPAGE = NPAGE + 1                                        INAD183
                                    CALL PAGEHG                                              INAD184
                                    RETURN                                                   INAD185
                                    END                                                      INAD186


      SYMBOLIC REFERENCE MAP (R=1)

 ENTRY POINTS
     1  INAID

 VARIABLES     SN  TYPE          RELOCATION
     3  AI          REAL                 / /              4  ARR        REAL                / /
     5  ARR8        REAL                 / /              8  DELCRK     REAL                / /
     1  DELST       REAL                 / /           1212  I          INTEGER
  1213  K           INTEGER                           22434  MISS       INTEGER    ARRAY    / /
 21458  N           INTEGER     ARRAY    / /          21464  N4         INTEGER             / /
 21465  NCONTP      INTEGER              / /           1216  NF         INTEGER
 21614  NFLTS       INTEGER     ARRAY    / /          23254  NIN        INTEGER    ARRAY    / /
 21470  NINSP       INTEGER              / /          21474  NJST       INTEGER             / /
 21473  NLEN        INTEGER              / /          21472  NMISS      INTEGER             / /
  1220  NNTT12      INTEGER                            1221  NN12P1     INTEGER
 21466  NP          INTEGER              / /          21530  NPAGE      INTEGER             / /
 21562  NPW         INTEGER     ARRAY    / /          23300  NRE        INTEGER    ARRAY    / /
 21471  NRENK       INTEGER              / /          21544  NTB1       INTEGER    ARRAY    / /
 21554  NTB12       INTEGER     ARRAY    / /           1222  NTB121     INTEGER
  1223  NTB122      INTEGER                           21557  NTB22      INTEGER    ARRAY    / /
 21467  NTMS        INTEGER              / /           1217  NTP        INTEGER
  1224  NTRE        INTEGER    *UNDEF                  1214  NTT1       INTEGER
  1215  NTT1P1      INTEGER                           21456  NTW1       INTEGER             / /
 21433  NTW2        INTEGER              / /          21532  NWT1       INTEGER    ARRAY    / /
 21540  NWT2        INTEGER     ARRAY    / /              0  P          REAL       ARRAY    / /
 24404  TABL1       REAL        ARRAY    / /          26354  TABL2      REAL       ARRAY    / /
     2  TIMAX       REAL                 / /

 FILE NAMES          MODE
        TAPE6        FMT

 EXTERNALS          TYPE   ARGS
        PAGEHG               0                      PCBM                 0
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      SUBROUTINE PCBM        74/74    OPT=1                              FTN 4.7+476         09/17/79  18.34.24          PAGE     1

                                   SUBROUTINE PCBM                                  PCBM  1
                  C          SUBROUTINE FOR CALCULATING THE MODIFIED PCB TABLE            PCBM  2
                                   COMMON P(9000), N(1500), TABL1(200,5), TABL2(1000,2) PCBM  3
                                   DIMENSION NTB1(5), CRACKL(100), PCBT(100)           PCBM  4
                                   EQUIVALENCE (N(61), NTB1)                            PCBM  41
                                   NCRL = 2 * NTB1(2) - 2                               PCBM  5
                                   CRACKL(1) = TABL1(1,2)                               PCBM  6
                                   NC = NTB1(2)                                         PCBM  7
                                   PCBT(1) = TABL1(NC+1,2)                              PCBM  8
                                   NCM1 = NC - 1                                        PCBM  9
                                   DO  10 J = 2, NCM1                                   PCBM 10
                                   CRACKL(2*J-2) = TABL1(J,2)                           PCBM 11
                                   CRACKL(2*J-1) = TABL1(J,2) * 1.000001                PCBM 12
                                   PCBT(2*J-2) = TABL1(NC+J,2)                          PCBM 13
                    10             PCBT(2*J-1) = TABL1(NC+J,2)                          PCBM 14
                                   CRACKL(2*NC-2) = TABL1(NC,2)                         PCBM 15
                                   PCBT(2*NC-2) = TABL1(2*NC,2)                         PCBM 16
                                   NTB1(5) = 2 * NC - 2                                 PCBM 17
                                   NCRL = NTB1(5)                                       PCBM 18
                                   DO  20 J = 1, NCRL                                   PCBM 19
                                   TABL1(J,5) = CRACKL(J)                               PCBM 20
                    20             TABL1(NCRL+J,5) = PCBT(J)                            PCBM 21
                                   RETURN                                               PCBM 22
                                   END                                                  PCBM 23


        SYMBOLIC REFERENCE MAP (R=1)

    ENTRY POINTS
      1   PCBM

    VARIABLES       SN  TYPE         RELOCATION
       50  CRACKL       REAL        ARRAY                       47  J           INTEGER
    21450  N            INTEGER     ARRAY      //               45  NC          INTEGER
       46  NCM1         INTEGER                                 44  NCRL        INTEGER
    21544  NTB1         INTEGER     ARRAY      //                6  P           REAL        ARRAY     //
      214  PCBT         REAL        ARRAY                    24404  TABL1       REAL        ARRAY     //
    26354  TABL2        REAL        ARRAY      //

    STATEMENT LABELS
        6  10                                      8  20

    LOOPS  LABEL     INDEX     FROM-TO     LENGTH    PROPERTIES
      17   10        J          11 15         5B      INSTACK
      36   20        J          20 22         4B      INSTACK

    COMMON BLOCKS    LENGTH
          //         13500

    STATISTICS
      PROGRAM LENGTH                  [illegible]     [illegible]
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                         SUBROUTINE CALC                                  CALC   1
          C      SUBROUTINE FOR CALCULATING THE TIME DEPENDENT FAILURE    CALC   2
          C      PROBABILITY FOR A CONTROL POINT                          CALC   3
                         COMMON P(9000), N(1500), TABL1(200,5), TABL2(1000,2) CALC   4
                         DIMENSION PSIL(50), PFBCT(400), TIMCLC(400),     CALC  41
               1 TIMI(20), TIMR(20), PCBT(100), CRACKL(100), TIME(400),   CALC   5
               2 DAREAP(100)                                              CALC  51
                         DIMENSION NTB1(5), NTB12(3), NTB22(3)            CALC  52
                         DIMENSION NFLTS(400), MISS(400), NIN(20), NRE(20), CALC  53
               1 NUMF(400)                                                CALC   6
                         EQUIVALENCE (P(1), DELCRK), (P(2), DELST)        CALC  61
                         EQUIVALENCE (P(50), RMISS)                       CALC  62
                         EQUIVALENCE (P(51), PFBC), (P(52), DLAREA)       CALC   7
                         EQUIVALENCE (P(101), PSIL), (P(151), PFBCT),     CALC   8
               1 (P(551), TIMCLC), (P(951), TIMI), (P(971), TIMR),        CALC   9
               2 (P(991), PCBT), (P(1091), CRACKL), (P(1191), TIME)       CALC  10
                         EQUIVALENCE (P(8791), DAREAP)                    CALC 101
                         EQUIVALENCE (N(15), NP), (N(16), NTMS),          CALC  11
               1 (N(17), NINSP), (N(18), NRENK), (N(22), NPRNT)           CALC  12
                         EQUIVALENCE (N(43), JINSP), (N(44), JRENK),      CALC 121
               1 (N(45), KT),                 (N(47), NPSIL), (N(50), NDCLC) CALC 122
                         EQUIVALENCE (N(61), NTB1), (N(69), NTB12),       CALC 123
               1 (N(72), NTB22)                                           CALC 124
                         EQUIVALENCE (N(101), NFLTS), (N(501), MISS),     CALC 125
               1 (N(901), NIN), (N(921), NRE), (N(351), NUMF)             CALC 126
                         DLAREA = DELCRK * DELST                          CALC 127
                         KT = 1                                           CALC  13
                         NDCLC = 1                                        CALC  14
                         NPSIL = NTB12(1)                                 CALC  15
                         NCRL = NTB1(5)                                   CALC  16
          C      COMPUTE THE DAREAP ELEMENTS                              CALC  16
                         DO     2 J = 1, NCRL                             CALC  17
                         CRACKL(J) = TABL1(J,5)                           CALC 171
              2          PCBT(J) = TABL1(NCRL+J,5)                        CALC 172
                         DO     4 J = 2, NCRL                             CALC 173
              4          DAREAP(J-1) = 0.5 * (PCBT(J) + PCBT(J-1))        CALC 174
               1 * (CRACKL(J) - CRACKL(J-1))                              CALC 175
          C      FIND THE STRESS ABSCISSAS IN THE STRESS PROB DEN FUNCTION TABL CALC 18
                         DO    10 I = 1, NPSIL                            CALC  19
             10          PSIL(I) = TABL2(I,1)                             CALC  20
          C      COMPUTE THE TIMES FOR FAILURE PROBABILITY CALCULATION    CALC  21
                         DO    20 I = 1, NTMS                             CALC  22
                         RNFLTS = NFLTS(I)                                CALC  23
             20          CALL TABS(TABL1(1,1), RNFLTS, TIMCLC(I), NTB1(1)) CALC  24
                         I = 1                                            CALC  25
          C      CHECK ON AREA UNDER THE CRACK DENSITY FUNCTION           CALC  26
             22          DO    30 J = 1, NCRL                             CALC  27
                         CRACKL(J) = TABL1(J,5)                           CALC  28
             30          PCBT(J) = TABL1(NCRL+J,5)                        CALC  29
                         CALL AREAC (CRACKL, PCBT, NCRL, AREA)            CALC  30
             40          WRITE (6,50) I, AREA                             CALC  32
             50  FORMAT (10X, 30HCRACK DENSITY AREA CALC. - TIME STEP =, I5, CALC  33
               1         4X, 6HAREA =, F8.4)                              CALC  34
          C      CORRECT THE CRACK DENSITY FUNCTION FOR AREA ERROR        CALC  36
             60          DO    70 J = 1, NCRL                             CALC  37
                         PCBT(J) = PCBT(J) / AREA                         CALC  38
             70          TABL1(NCRL+J,5) = PCBT(J)                        CALC 381
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      C     CHECK ON MISSION BEING FLOWN                                  CALC 39
                  RMISS = MISS(I)                                         CALC 441
                  CALL PCALC                                              CALC 461
                  PFBCT(KT) = PFBC                                        CALC 47
                  TIME(KT) = TIMCLC(I)                                    CALC 48
                  NUMF(KT) = NFLTS(I)                                     CALC 481
      C     CHECK FOR END OF RUN                                          CALC 49
                  IF (I - NTMS) 110, 230, 230                             CALC 50
        110       RNFLT1 = NFLTS(I+1)                                     CALC 511
                  CALL TABS(TABL1(1,1), RNFLT1, TIMCLC(I+1), NTB1(1))     CALC 512
      C     CHECK FOR INSPECTION BEFORE NEXT TIME STEP                    CALC 513
                  IF (NINSP) 120, 160                                     CALC 514
        120       DO  130 J = 1, NINSP                                    CALC 52
                  IF (NIN(J) - NFLTS(I)) 130, 140                         CALC 53
        130       CONTINUE                                                CALC 55
                  GO TO 160                                               CALC 56
        140       JINSP = J                                               CALC 57
                  RNIN = NIN(JINSP)                                       CALC 58
                  CALL TABS(TABL1(1,1), RNIN, TIMI(JINSP), NTB1(1))       CALC 581
                  CALL INSPEC                                             CALC 62
                  CALL PCALC                                              CALC 63
                  KT = KT + 1                                             CALC 64
                  PFBCT(KT) = PFBC                                        CALC 65
                  TIME(KT) = TIMI(JINSP)                                  CALC 66
                  NUMF(KT) = NFLTS(I)                                     CALC 661
      C     CHECK FOR REWORK BEFORE NEXT TIME STEP                        CALC 67
        160       IF (NREWK) 170, 210                                     CALC 671
        170       DO  190 J = 1, NREWK                                    CALC 68
                  IF (NRE(J) - NFLTS(I)) 180, 190                         CALC 69
        180       CONTINUE                                                CALC 71
                  GO TO 210                                               CALC 72
        190       JREWK = J                                               CALC 73
                  RNRE = NRE(JREWK)                                       CALC 74
                  CALL TABS(TABL1(1,1), RNRE, TIMR(JREWK), NTB1(1))       CALC 741
                  CALL REWORK                                             CALC 84
                  CALL PCALC                                              CALC 85
                  KT = KT + 1                                             CALC 86
                  PFBCT(KT) = PFBC                                        CALC 87
                  TIME(KT) = TIMR(JREWK)                                  CALC 88
                  NUMF(KT) = NFLTS(I)                                     CALC 881
        210       DELTIM = TIMCLC(I+1) - TIME(KT)                         CALC 89
                  NCRL = NTB1(5)                                          CALC 891
                  DO  221 J = 1, NCRL                                     CALC 90
                  IF (CRACKL(J)) 212, 220                                 CALC 901
        212       CALL TABDSI(TABL2(1,2), CRACKL(J), RMISS, TB,           CALC 902
           1    NTB12(2), NTB22(2))                                       CALC 903
        218       TIN = TB + DELTIM                                       CALC 922
                  CALL TABDS(TABL2(1,2), TIN, RMISS, CRACKL(J),           CALC 93
           1    NTB12(2), NTB22(2))                                       CALC 931
        220       TABL1(J,5) = CRACKL(J)                                  CALC 94
        221       CONTINUE                                                CALC 941
                  IF (NPRNT) 223, 225                                     CALC 941
        223       WRITE (6,224) (CRACKL(M), M = 1, NCRL)                  CALC 941
        224 FORMAT (1P10E12.4)                                            CALC 941
        225       DO  226 J = 2, NCRL, 2                                  CALC 942
                  DUMJ = PCBT(J)                                          CALC 943
                  DUMJM1 = PCBT(J-1)                                      CALC 944
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   115                       IF (DUMJ) 2251, 2252                                CALC 944
              2251           PCBT(J) = DAREAP(J-1) * DUMJ /                      CALC 945
                 1      (0.5 * (DUMJ + DUMJM1) * (CRACKL(J) - CRACKL(J-1)))      CALC 946
              2252           IF (DUMJM1) 2253, 226                               CALC 946
              2253           PCBT(J-1) = DAREAP(J-1) * DUMJM1 /                  CALC 947
   120           1      (0.5 * (DUMJ + DUMJM1) * (CRACKL(J) - CRACKL(J-1)))      CALC 948
              226            CONTINUE                                            CALC 949
                             DO  228 J = 1, NCRL                                 CALC 950
              228            TABL1(NCRL+J,5) = PCBT(J)                           CALC 951
                             KT = KT + 1                                         CALC 952
   125        230            I = I + 1                                           CALC 96
                             IF (I - NTMS) 22, 22, 240                           CALC 961
              240            CALL FINCLC                                         CALC 97
              250            RETURN                                              CALC 98
                             END                                                 CALC 99
```

```
     SYMBOLIC REFERENCE MAP (R=1)

 ENTRY POINTS
     1  CALC

 VARIABLES      SN   TYPE            RELOCATION
    364  AREA        REAL                              2102  CRACKL     REAL        ARRAY    / /
  21126  DAREAP      REAL        ARRAY    / /             0  DELCRK     REAL                 / /
      1  DELST       REAL                 / /           370  DELTIM     REAL
     63  DLAREA      REAL                 / /           374  DUMJ       REAL
    375  DUMJM1      REAL                               362  I          INTEGER
    361  J           INTEGER                          21522  JINSP      INTEGER              / /
  21523  JRENK       INTEGER              / /         21524  KT         INTEGER              / /
    373  N           INTEGER                          22434  MTSS       INTEGER     ARRAY    / /
  21450  N           INTEGER     ARRAY    / /           360  NCRL       INTEGER
  21531  NDCLC       INTEGER              / /         21616  NFLTS      INTEGER     ARRAY    / /
  23254  NIN         INTEGER     ARRAY    / /         21470  NINSP      INTEGER              / /
  21456  NP          INTEGER              / /         21475  NPRNT      INTEGER              / /
  21526  NPSIL       INTEGER              / /         23300  NRE        INTEGER     ARRAY    / /
  21471  NRENK       INTEGER              / /         21544  NTB1       INTEGER     ARRAY    / /
  21554  NTB12       INTEGER     ARRAY    / /         21557  NTB22      INTEGER     ARRAY    / /
  21467  NTMS        INTEGER              / /         23350  NUMF       INTEGER     ARRAY    / /
      0  P           REAL        ARRAY    / /          1736  PCBT       REAL        ARRAY    / /
     62  PFBC        REAL                 / /           226  PFECT      REAL        ARRAY    / /
    144  PSIL        REAL        ARRAY    / /            61  RN""S      REAL                 / /
    363  RNFLTS      REAL                               365  RNFLT1     REAL
    366  RSIN        REAL                               367  RARE       REAL
  24404  TABL1       REAL        ARRAY    / /         26354  TABL2      REAL        ARRAY    / /
    371  TB          REAL                               372  TIN        REAL
   1046  TIMCLC      REAL        ARRAY    / /          2246  TIME       REAL        ARRAY    / /
   1666  TIMI        REAL        ARRAY    / /          1712  TIMR       REAL        ARRAY    / /

 FILE NAMES          MODE
       TAPE6         FMT
```

```
      SUBROUTINE PCALC                                                  PCLC   1
C     SUBROUTINE FOR CALCULATING THE SINGLE FLIGHT FAILURE              PCLC   2
C     PROBABILITY                                                       PCLC   3
      COMMON P(9000), N(1500), TABL1(200,5), TABL2(1000,2)              PCLC   4
      DIMENSION PSIL(50), PDPSI(50)                                     PCLC   5
      DIMENSION NTB1(6), NTB12(3), NTB22(3)                             PCLC  51
      EQUIVALENCE (P(1), DELCRK), (P(2), DELST)                         PCLC   6
      EQUIVALENCE (P(50), RMISS)                                        PCLC  61
      EQUIVALENCE (P(51), PFBC), (P(52), DLAREA)                        PCLC   7
      EQUIVALENCE (P(101), PSIL)                                        PCLC   8
      EQUIVALENCE (N(19), NMISS), (N(20), NLEN),                        PCLC  91
     1 (N(21), NJST)                                                    PCLC  92
      EQUIVALENCE (N(61), NTB1), (N(69), NTB12),                        PCLC  93
     1 (N(72), NTB22)                                                   PCLC  94
      EQUIVALENCE (N(47), NPSIL),                                       PCLC  10
     1 (N(50), NDCLC)                                                   PCLC 101
C     FIND THE STRESS DENSITY FUNCTION                                  PCLC  11
      IF (NDCLC) 5, 105                                                 PCLC  12
    5 NMISS = NTB22(1)                                                  PCLC 121
      DO 101 MISSN = 1, NMISS                                           PCLC 122
   10 DO 20 I = 1, NPSIL                                                PCLC  13
      NI = NTB12(1) + NTB22(1) + (MISSN - 1) * NTB12(1)                 PCLC  14
     1 + I                                                              PCLC  15
   20 PDPSI(I) = TABL2(NI,1)                                            PCLC  16
C     CHECK AREA UNDER THE DENSITY FUNCTION                             PCLC  41
      NC = NTB12(1) + NTB22(1) + (MISSN - 1) * NTB12(1)                 PCLC 411
   90 CALL AREAS(PSIL, PDPSI, NPSIL, AREA)                              PCLC  42
   92 WRITE (6,94) AREA                                                 PCLC  44
   94 FORMAT (10X, 38HSTRESS DENSITY FUNCTION CALC. - AREA =, F8.4)     PCLC  45
      DO 95 I = 1, NPSIL                                                PCLC 451
   95 PDPSI(I) = PDPSI(I) / AREA                                        PCLC  46
C     PLACE THE STRESS DENSITY FUNCTION IN A TABLE                      PCLC 461
   96 NTB121 = NTB12(1)                                                 PCLC 462
      DO 100 I = 1, NPSIL                                               PCLC  48
  100 TABL2(NC+I,1) = PDPSI(I)                                          PCLC  50
  101 CONTINUE                                                          PCLC 501
      NDCLC = 0                                                         PCLC 502
C     COMPUTE THE SINGLE FLIGHT FAILURE PROBABILITY                     PCLC  51
  105 PFBC = 0.0                                                        PCLC  52
      DO 120 LEN = 1, NLEN                                              PCLC  53
      DO 120 JST = 1, NJST                                              PCLC  54
      RLEN = LEN                                                        PCLC 541
      RJST = JST                                                        PCLC 542
      CRKLEN = (RLEN - 0.5) * DELCRK                                    PCLC  55
      STRESS = (RJST - 0.5) * DELST                                     PCLC  56
      CALL TABS(TABL1(1,4), CRKLEN, SCB, NTB1(4))                       PCLC  57
      IF (STRESS - SCB) 120, 110, 110                                   PCLC  58
  110 CALL TABDS(TABL2(1,1), STRESS, RMISS, PDSBC,                      PCLC  59
     1 NTB12(1), NTB22(1))                                              PCLC 591
      IF (PDSBC) 115, 120                                               PCLC 592
  115 CALL TABS (TABL1(1,5), CRKLEN, PCB, NTB1(5))                      PCLC  60
      PFBC = PCB * PDSBC * DLAREA + PFBC                                PCLC  61
  120 CONTINUE                                                          PCLC  62
      RETURN                                                            PCLC  63
      END                                                               PCLC  64
```

```
                  SUBROUTINE INSPEC                                        INSP   1
C     SUBROUTINE TO MODIFY THE CRACK DISTRIBUTION AFTER INSPECTION         INSP   2
                  COMMON P(9000), N(1500), TABL1(200,5), TABL2(1000,2)     INSP   3
                  DIMENSION PCBT(100), CRACKL(100), DUM(100),              INSP   4
         1 DUML(100), DAREAP(100)                                          INSP  41
                  DIMENSION NTB1(5)                                        INSP   5
                  EQUIVALENCE (P(4), AI)                                   INSP   6
                  EQUIVALENCE (P(991), PCBT), (P(1091), CRACKL),           INSP  61
         1 (P(8791), DAREAP)                                               INSP   7
                  EQUIVALENCE (N(43), JINSP)                               INSP  71
                  EQUIVALENCE (N(61), NTB1)                                INSP  72
                  NCRL = NTB1(5)                                           INSP   8
                  DO   10 I = 1, NCRL                                      INSP   9
                  CALL TABS(TABL1(1,3), CRACKL(I), PI, NTB1(3))            INSP  12
      10          PCBT(I) = PI * PCBT(I)                                   INSP  13
                  CALL AREAC(CRACKL, PCBT, NTB1(5), AREAI)                 INSP  14
                  DO   30 I = 1, NCRL                                      INSP  15
                  IF (CRACKL(I) - AI) 20, 40, 40                           INSP  16
      20          PCBT(I) = PCBT(I) + (1.0 - AREAI) / AI                   INSP  17
      30          CONTINUE                                                 INSP  18
      40          ICNT = I                                                 INSP  19
                  DO   50 J = ICNT, NCRL                                   INSP  20
                  DUM(J) = PCBT(J)                                         INSP  21
      50          DUML(J) = CRACKL(J)                                      INSP  22
                  DO   60 J = ICNT, NCRL                                   INSP  23
                  PCBT(J+2) = DUM(J)                                       INSP  24
      60          CRACKL(J+2) = DUML(J)                                    INSP  25
                  CALL TABS(TABL1(1,3), AI, PI, NTB1(3))                   INSP  26
                  CALL TABS(TABL1(1,5), AI, PCB, NTB1(5))                  INSP  27
                  CALL TABS(TABL1(1,5), AI, PCB, NTB1(2))                  INSP  27
                  PCBT(ICNT) = PI * PCB + (1.0 - AREAI) / AI               INSP  28
                  PCBT(ICNT+1) = PI * PCB                                  INSP  29
                  CRACKL(ICNT) = AI                                        INSP  30
                  CRACKL(ICNT+1) = AI * 1.0000001                          INSP  31
                  IF (CRACKL(ICNT+1) - CRACKL(ICNT+2)) 90, 70, 70          INSP  32
      70          WRITE (6,80)                                             INSP  33
      80    FORMAT (10X, 27HCRACK LENGTH ERROR - INSPEC)                   INSP  34
                  CALL GUIDE                                               INSP  35
      90          NTB1(5) = NTB1(5) + 2                                    INSP  36
                  CALL AREAC(CRACKL, PCBT, NTB1(5), AREAN)                 INSP  37
     100          WRITE (6,110) NTB1(5), AREAN                             INSP  39
     110    FORMAT (10X, 39HCRACK DENSITY AREA CALC. - NO. OF PTS =, I5,   INSP  40
         1            4X, 6HAREA =, F8.5, 2X, 6HINSPEC)                    INSP  41
                  NCRL = NTB1(5)                                           INSP  42
                  DO  115 J = 1, NCRL                                      INSP  43
                  TABL1(J,5) = CRACKL(J)                                   INSP  44
                  PCBT(J) = PCBT(J) / AREAN                                INSP  45
     115          TABL1(NCRL+J,5) = PCBT(J)                                INSP  46
                  DO  116 J = 2, NCRL                                      INSP 461
     116          DAREAP(J-1) = 0.5 * (PCBT(J) + PCBT(J-1))                INSP 462
         1 * (CRACKL(J) - CRACKL(J-1))                                     INSP 463
     120          RETURN                                                   INSP  47
                  END                                                      INSP  48
```

```
                 SUBROUTINE REWORK                                         REWK  1
      C  SUBROUTINE TO MODIFY THE CRACK DISTRIBUTION AFTER REWORK          REWK  2
                 COMMON P(9000), N(1500), TABL1(200,5), TABL2(1000,2)      REWK  3
                 DIMENSION PCBT(100), CRACKL(100), DUM(100),               REWK  4
           1  DUML(100), DAREAP(100)                                       REWK 41
                 DIMENSION NTB1(5)                                         REWK  5
                 EQUIVALENCE (P(5), ARR), (P(6), ARR0)                     REWK  6
                 EQUIVALENCE (P(991), PCBT), (P(1091), CRACKL),            REWK 61
           1  (P(8791), DAREAP)                                            REWK  7
                 EQUIVALENCE (N(44), JREWK)                                REWK 71
                 EQUIVALENCE (N(61), NTB1)                                 REWK 72
                 NCRL = NTB1(5)                                            REWK  8
                 DO   10 I = 1, NCRL                                       REWK  9
                 CRACKL(I) = TABL1(I,5)                                    REWK 10
          10     PCBT(I) = TABL1(I+NSPL,5)                                 REWK 11
      C  COMPUTE NUMBER OF ABSCISSAS LESS THAN ARR0                        REWK 12
                 NCNT = 0                                                  REWK 13
                 DO   30 I = 1, NCRL                                       REWK 14
                 IF (CRACKL(I) - ARR0) 20, 30, 30                          REWK 15
          20     NCNT = NCNT + 1                                           REWK 16
          30     CONTINUE                                                  REWK 17
      C  DETERMINE IF NCNT IS ODD OR EVEN                                  REWK 18
                 MTEST = 1                                                 REWK 19
                 DO   40 I = 1, NCNT                                       REWK 20
          40     MTEST = - MTEST                                           REWK 21
      C  REORDER THE CRACK DISTRIBUTION FUNCTION                           REWK 22
                 IF (MTEST) 50, 150, 80                                    REWK 23
          50     NCNTM1 = NCNT - 1                                         REWK 24
                 NCRLT = NCRL - NCNTM1                                     REWK 25
                 DO   60 I = 2, NCRLT                                      REWK 26
                 DUM(I) = PCBT(I+NCNTM1)                                   REWK 27
          60     DUML(I) = CRACKL(I+NCNTM1)                                REWK 28
                 DO   70 I = 2, NCRLT                                      REWK 29
                 PCBT(I) = DUM(I)                                          REWK 30
          70     CRACKL(I) = DUML(I) - ARR                                 REWK 31
                 NTB1(5) = NCRLT                                           REWK 32
                 CRACKL(1) = 0.0                                           REWK 33
                 GO TO 110                                                 REWK 34
          80     NCNTM2 = NCNT - 2                                         REWK 35
                 NCRLT = NCRL - NCNTM2                                     REWK 36
                 DO   90 I = 3, NCRLT                                      REWK 37
                 DUM(I) = PCBT(I+NCNTM2)                                   REWK 38
          90     DUML(I) = CRACKL(I+NCNTM2)                                REWK 39
                 DO  100 I = 3, NCRLT                                      REWK 40
                 PCBT(I) = DUM(I)                                          REWK 41
         100     CRACKL(I) = DUML(I) - ARR                                 REWK 42
                 NTB1(5) = NCRLT                                           REWK 43
                 CRACKL(1) = 0.0                                           REWK 44
                 CRACKL(2) = CRACKL(3) - 0.0000001                         REWK 45
         110     PCBT(1) = 0.0                                             REWK 46
                 PCBT(2) = 0.0                                             REWK 47
                 CALL AREAC(CRACKL, PCBT, NTB1(5), AREA1)                  REWK 48
                 PCBT(1) = (1.0 - AREA1) / CRACKL(2)                       REWK 49
                 PCBT(2) = PCBT(1)                                         REWK 50
      C  NORMALIZE AREA UNDER DISTRIBUTION FUNCTION                        REWK 51
                 CALL AREAC(CRACKL, PCBT, NTB1(5), AREAR)                  REWK 52
                 WRITE (6,120) NTB1(5), AREAR                              REWK 53
```

```
               120      FORMAT (10X, 39HCRACK DENSITY AREA CALC. - NO. OF PTS =, I5,   REWK 54
                    1             4X, 6HAREA =, F9.5, 2X, 7HREWORK2)                   REWK 55
      60                          DO  130 I = 1, NCRLT                                 REWK 56
                                  PCBT(I) = PCBT(I) / AREAR                            REWK 57
                                  TABL1(I,5) = CRACKL(I)                               REWK 58
               130                TABL1(I+NCRLT,5) = PCBT(I)                           REWK 59
                                  DO  140 J = 2, NCRLT                                 REWK 60
      65       140                DAREAP(J-1) = 0.5 * (PCBT(J) + PCBT(J-1))            REWK 61
                    1   * (CRACKL(J) - CRACKL(J-1))                                    REWK 62
               150                RETURN                                               REWK 63
                                  END                                                  REWK 64
```

```
     SYMBOLIC REFERENCE MAP (R=1)

ENTRY POINTS
    1   REWORK

VARIABLES      SN  TYPE             RELOCATION
   221  AREAR      REAL                              220  AREA1    REAL
     4  ARR        REAL                 //             5  ARR0     REAL               //
  2102  CRACKL     REAL       ARRAY     //         21126  DAREAP   REAL       ARRAY   //
   223  DUM        REAL       ARRAY                  367  DUML     REAL       ARRAY
   212  I          INTEGER                           222  J        INTEGER
 21523  JREWK      INTEGER              //           214  NTEST    INTEGER
 21450  N          INTEGER    ARRAY     //           213  NCNT     INTEGER
   215  NCNTH1     INTEGER                           217  NCNTH2   INTEGER
   211  NCRL       INTEGER                           216  NCRLT    INTEGER
 21544  NTB1       INTEGER    ARRAY     //             0  P        REAL       ARRAY   //
  1736  PCBT       REAL       ARRAY     //         24404  TABL1    REAL       ARRAY   //
 26354  TABL2      REAL       ARRAY     //

FILE NAMES         MODE
        TAPE6      FMT

EXTERNALS          TYPE    ARGS
        AREAC                4

STATEMENT LABELS
     0  10                            0  20        INACTIVE            25  30
     0  40                            0  50        INACTIVE             0  60
     0  70                           66  80                             0  90
     0  100                         117  110                          175  120    FMT
     0  130                           0  140                          155  150

LOOPS  LABEL   INDEX    FROM-TO    LENGTH    PROPERTIES
   10  10      I        13 15      4B        INSTACK
   21  30      I        18 21      5B        INSTACK
   32  40      I        24 25      2B        INSTACK
   47  60      I        30 32      4B        INSTACK
   56  70      I        33 35      5B        INSTACK
   76  90      I        41 43      4B        INSTACK
  105  100     I        44 46      5B        INSTACK
  136  130     I        60 63      4B        INSTACK
```

```
                  SUBROUTINE FINCLC                                        FCLC  1
      C     SUBROUTINE FOR COMPUTING THE EXPECTED NUMBER OF FAILURES       FCLC  2
      C     IN A FLEET                                                     FCLC  3
                  COMMON P(9000), N(1500), TABL1(200,5), TABL2(1000,2)     FCLC  4
                  DIMENSION PFBCT(400), TIME(400), PFBT(400,15),           FCLC  5
           1      PFT(400), PF(400), PFF(400)                              FCLC  6
                  DIMENSION NTB1(5), NFLTS(400), NPW(15)                   FCLC 61
                  EQUIVALENCE (P(151), PFBCT), (P(1191), TIME),            FCLC  7
           1      (P(1591), PFBT), (P(7591), PFT), (P(7991), PF), (P(8391), PFF)  FCLC  8
                  EQUIVALENCE (N(13), NA), (N(14), NCONTP),                FCLC  9
           1      (N(15), NP), (N(16), NTMS)                               FCLC 10
                  EQUIVALENCE (N(61), NTB1)                                FCLC 101
                  EQUIVALENCE (N(45), KT)                                  FCLC 102
                  EQUIVALENCE (N(75), NPW)                                 FCLC 11
                  EQUIVALENCE (N(101), NFLTS)                              FCLC 111
                  PRODT = 1.0                                              FCLC 112
                  DO   10 I = 1, KT                                        FCLC 12
         10       PFBT(I,NCONTP) = PFBCT(I)                                FCLC 13
                  IF (NCONTP - NP) 120, 20, 20                             FCLC 14
      C     COMPUTE THE SINGLE FLIGHT PROBABILITY OF FAILURE FOR THE       FCLC 15
      C     AIRCRAFT                                                       FCLC 16
         20       DO   40 I = 1, KT                                        FCLC 17
                  PROD = 1.0                                               FCLC 18
                  DO   30 J = 1, NP                                        FCLC 19
                  NPWJ = NPW(J)                                            FCLC 191
                  DO   30 K = 1, NPWJ                                      FCLC 192
         30       PROD = (1.0 - PFBT(I,J)) * PROD                          FCLC 20
         40       PFT(I) = 1.0 - PROD                                      FCLC 21
      C     COMPUTE THE PROBABILITY OF FAILURE FOR THE AIRCRAFT            FCLC 22
                  NF1 = 0                                                  FCLC 221
                  NT = 1                                                   FCLC 222
                  TIM = TIME(1)                                            FCLC 223
                  DO   75 I = 2, KT                                        FCLC 23
                  DLTIM = TIME(I) - TIM                                    FCLC 24
                  TIM = TIME(I)                                            FCLC 25
                  IF (DLTIM) 50, 45                                        FCLC 26
         45       PF(I) = PF(I-1)                                          FCLC 261
                  GO TO 75                                                 FCLC 262
         50       NT = NT + 1                                              FCLC 27
                  NF = NFLTS(NT) - NF1                                     FCLC 28
                  NF1 = NFLTS(NT)                                          FCLC 281
                  RNF = NF                                                 FCLC 29
                  DO   60 J = 1, NF                                        FCLC 31
                  RJ = J                                                   FCLC 311
         60       PRODT = (1.0 - ((PFT(I) - PFT(I-1)) * RJ /               FCLC 32
           1      RNF + PFT(I-1))) * PRODT                                 FCLC 33
         70       PF(I) = 1.0 - PRODT                                      FCLC 34
         75       CONTINUE                                                 FCLC 35
      C     COMPUTE THE EXPECTED NUMBER OF FAILURES IN THE FORCE           FCLC 37
         90       RNA = NA                                                 FCLC 38
        100       DO   110 I = 2, KT                                       FCLC 39
        110       PFF(I) = RNA * PF(I)                                     FCLC 40
        120       RETURN                                                   FCLC 41
                  END                                                      FCLC 42
```

```
                          SUBROUTINE AREAC (X, Y, NPTS, AREA)           AREA  1
            C       SUBROUTINE TO C.MPUTE THE AREA UNDER A SIMPLE GRAPH BASED ON AREA  2
            C       THE TRAPAZOIDAL RULE                                AREA  3
            C       NPTS = NUMBER OF X,Y PAIRS                          AREA  4
                          DIMENSION X(100), Y(100)                      AREA  5
                          AREA = 0.0                                    AREA  6
                          NPTSM1 = NPTS - 1                             AREA  7
                          DO   10 I = 1, NPTSM1                         AREA  8
                          AREA = 0.5 * (Y(I+1) + Y(I)) * (X(I+1) - X(I)) AREA  9
            10       1    + AREA                                        AREA 10
                          RETURN                                        AREA 11
                          END                                           AREA 12
```

```
       SYMBOLIC REFERENCE MAP (R=1)

  ENTRY POINTS
      3  AREAC

  VARIABLES      SN  TYPE            RELOCATION
      0  AREA         REAL                  F.P.        27  I          INTEGER
      0  NPTS         INTEGER               F.P.        26  NPTSM1     INTEGER
      0  X            REAL        ARRAY     F.P.         0  Y          REAL       ARRAY     F.P.

  STATEMENT LABELS
      0  10

  LOOPS  LABEL    INDEX    FROM-TO    LENGTH    PROPERTIES
    16   10       I         8 9        60        INSTACK

  STATISTICS
    PROGRAM LENGTH                     32B      26
        52000B CM USED
```

```
                  SUBROUTINE AREAS (X, Y, NPTS, AREA)                          AREA  1
C       SUBROUTINE TO COMPUTE THE AREA UNDER A SIMPLE GRAPH BASED ON          AREA  2
C       THE TRAPAZOIDAL RULE                                                   AREA  3
C       NPTS = NUMBER OF X,Y PAIRS                                             AREA  4
                  DIMENSION X(50), Y(50)                                       AREA  5
                  AREA = 0.0                                                   AREA  6
                  NPTSM1 = NPTS - 1                                            AREA  7
                  DO   10 I = 1, NPTSM1                                        AREA  8
          10      AREA = 0.5 * (Y(I+1) + Y(I)) * (X(I+1) - X(I))               AREA  9
               1  + AREA                                                       AREA 10
                  RETURN                                                       AREA 11
                  END                                                          AREA 12
```

```
     SYMBOLIC REFERENCE MAP (R=1)

ENTRY POINTS
   3  AREAS

VARIABLES     SN   TYPE            RELOCATION
   0  AREA         REAL               F.P.          27  I         INTEGER
   0  NPTS         INTEGER            F.P.          26  NPTSM1    INTEGER
   0  X            REAL       ARRAY   F.P.           0  Y         REAL        ARRAY    F.P.

STATEMENT LABELS
   0  10

LOOPS  LABEL    INDEX    FROM-TO    LENGTH    PROPERTIES
  16   10       I          8 9        6B       INSTACK

STATISTICS
  PROGRAM LENGTH                  32B       26
       52000B CM USED
```

```
SUBROUTINE TABS        74/74    OPT=1                                   FTN 4.7+476        09/17/79  18.34.24        PAGE      1

                              SUBROUTINE TABS (TABLE, X1ARG, AMP, NTAB1)              STAB  1
                    C   SUBROUTINE FOR STRAIGHT LINE INTERPOLATION IN A SINGLE TABLE  STAB  2
                    C   LOOK UP                                                       STAB  3
                              DIMENSION TABLE(200)                                    STAB  4
                              DO    10 I1 = 1, NTAB1                                  STAB  5
                              IF (TABLE(I1) - X1ARG) 10, 20, 20                       STAB  6
                         10   CONTINUE                                                STAB  7
                              I1 = NTAB1                                              STAB  8
                         20   IF (I1 - 1) 30, 30, 40                                  STAB  9
                         30   I1 = 2                                                  STAB 10
                         40   N2 = NTAB1 + I1                                         STAB 11
                              N1 = N2 - 1                                             STAB 12
                              X1RAT = (X1ARG - TABLE(I1-1)) /                         STAB 13
                           1  (TABLE(I1) - TABLE(I1-1))                               STAB 14
                              AMP = TABLE(N1) + X1RAT * (TABLE(N2) - TABLE(N1))       STAB 15
                              RETURN                                                  STAB 16
                              END                                                     STAB 17


     SYMBOLIC REFERENCE MAP (R=1)

ENTRY POINTS
   3  TABS

VARIABLES     SN   TYPE           RELOCATION
    0  AMP         REAL               F.P.          35  I1        INTEGER
    0  NTAB1       INTEGER            F.P.          37  N1        INTEGER
   36  N2          INTEGER                           0  TABLE     REAL       ARRAY    F.P.
    0  X1ARG       REAL               F.P.          40  X1RAT     REAL

STATEMENT LABELS
    0  10                               16  20                                   0  30          INACTIVE
   21  40

LOOPS  LABEL    INDEX     FROM-TO    LENGTH    PROPERTIES     EXITS
   7   10     * I1          5 7        5B       INSTACK

STATISTICS
  PROGRAM LENGTH                45B        37
        52000B CM USED
```

```
                        SUBROUTINE TABDS(TABLE, X1ARG, X2ARG, AMP,                     DTAB  1
             1    NTAB1, NTAB2)                                                        DTAB  2
      C           SUBROUTINE FOR STRAIGHT LINE INTERPOLATION IN A DOUBLE TABLE         DTAB  3
      C           LOOK UP                                                              DTAB  4
                        DIMENSION TABLE (1000)                                         DTAB  5
                        DO   10 I1 = 1, NTAB1                                          DTAB  6
                        IF (TABLE(I1) - X1ARG) 10, 20, 20                              DTAB  7
         10             CONTINUE                                                       DTAB  8
                        I1 = NTAB1                                                     DTAB  9
         20             IF (I1 - 1) 30, 30, 40                                         DTAB 10
         30             I1 = 2                                                         DTAB 11
         40             NT1P1 = NTAB1 + 1                                              DTAB 12
                        NN12 = NTAB1 + NTAB2                                           DTAB 13
                        DO   50 I2 = NT1P1, NN12                                       DTAB 14
                        IF (TABLE(I2) - X2ARG) 50, 80, 60                              DTAB 15
         50             CONTINUE                                                       DTAB 16
         60             WRITE (6,70) I2, X2ARG, TABLE(I2)                              DTAB 17
         70       FORMAT (10X, 11HTABDS ERROR, 2X, 4HI2 =, I5, 2X, 7HX2ARG =,          DTAB 18
             1    E15.7, 2X, 11HTABLE(I2) =, E15.7)                                    DTAB 181
         80             N22 = NN12 + (I2 - NTAB1 - 1) * NTAB1 + I1                     DTAB 20
                        N12 = N22 - 1                                                  DTAB 21
                        X1RAT = (X1ARG - TABLE(I1-1)) /                                DTAB 24
             1    (TABLE(I1) - TABLE(I1-1))                                            DTAB 25
                        AMP  = TABLE(N12) + X1RAT * (TABLE(N22) -                      DTAB 30
             1    TABLE(N12))                                                          DTAB 31
                        RETURN                                                         DTAB 33
                        END                                                            DTAB 34
```

```
SYMBOLIC REFERENCE MAP (R=1)

ENTRY POINTS
    3  TABDS

VARIABLES     SN  TYPE           RELOCATION
    0  AMP        REAL             F.P.        74  I1        INTEGER
   77  I2         INTEGER                      76  NN12      INTEGER
    0  NTAB1      INTEGER          F.P.         0  NTAB2     INTEGER                F.P.
   75  NT1P1      INTEGER                     101  N12       INTEGER
  100  N22        INTEGER                       0  TABLE     REAL       ARRAY       F.P.
    0  X1ARG      REAL             F.P.       102  X1RAT     REAL
    0  X2ARG      REAL             F.P.

FILE NAMES        MODE
     TAPE6        FMT

STATEMENT LABELS
    0  10                          16  20                          0  30        INACTIVE
   21  40                           0  50                         33  60
   64  70      FMT                 40  80

LOOPS  LABEL    INDEX     FROM-TO    LENGTH    PROPERTIES
    7  10     * I1          6 8        5B       INSTACK     EXITS
   25  50     * I2         14 16       6B       INSTACK     EXITS
```

```
                            SUBROUTINE TABDSI(TABLE, X1ARG, X2ARG, AMP,        DTBI  1
              1   NTAB1, NTAB2)                                                 DTBI  2
           C      SUBROUTINE FOR STRAIGHT LINE INTERPOLATION IN A DOUBLE        DTBI  3
           C      TABLE LOOK UP - INVERSE FUNCTION                              DTBI  4
                            DIMENSION TABLE (1000)                              DTBI  5
                            NT1P1 = NTAB1 + 1                                   DTBI  6
                            NN12  = NTAB1 + NTAB2                               DTBI  7
                            DO   10 I2 = NT1P1, NN12                            DTBI  8
                            IF (TABLE(I2) - X2ARG) 10, 40, 20                   DTBI  9
             10             CONTINUE                                            DTBI 10
             20             WRITE (6,30) I2, X2ARG, TABLE(I2)                   DTBI 11
             30   FORMAT (10X, 12HTABDSI ERROR, 2X, 4HI2 =, I5, 2X, 7HX2ARG =,  DTBI 12
              1   E15.7, 2X, //11HTABLE(I2) =, E15.7)                           DTBI 13
             40             DO   50 I1 = 1, NTAB1                               DTBI 14
                            N22 = NN12 + (I2 - NTAB1 - 1) * NTAB1 + I1          DTBI 15
                            IF (TABLE(N22) - X1ARG) 50, 60, 60                  DTBI 16
             50             CONTINUE                                            DTBI 17
                            I1 = NTAB1                                          DTBI 171
             60             IF (I1 - 1) 70, 70, 80                              DTBI 18
             70             I1 = 2                                              DTBI 19
                            N22 = NN12 + (I2 - NTAB1 - 1) * NTAB1 + 2           DTBI 20
             80             X1RAT = (X1ARG - TABLE(N22-1)) /                    DTBI 21
              1   (TABLE(N22) - TABLE(N22-1))                                   DTBI 22
                            AMP = TABLE(I1 - 1) + X1RAT * (TABLE(I1) -          DTBI 23
              1   TABLE(I1-1))                                                  DTBI 24
                            RETURN                                              DTBI 25
                            END                                                 DTBI 26
```

```
    SYMBOLIC REFERENCE MAP (R=1)

 ENTRY POINTS
     3  TABDSI

 VARIABLES      SN  TYPE          RELOCATION
     0  AMP         REAL               F.P.      103  I1       INTEGER
   102  I2          INTEGER                      101  NN12     INTEGER
     0  NTAB1       INTEGER            F.P.        0  NTAB2    INTEGER        F.P.
   100  NT1P1       INTEGER                      104  N22      INTEGER
     0  TABLE       REAL       ARRAY   F.P.        0  X1ARG    REAL           F.P.
   105  X1RAT       REAL                           0  X2ARG    REAL           F.P.

 FILE NAMES         MODE
     TAPE6          FMT

 STATEMENT LABELS
     0  10                           20  20                          67  30     FMT
    25  40                            0  50                          40  60
     0  70          INACTIVE         47  80

 LOOPS  LABEL    INDEX     FROM-TO    LENGTH   PROPERTIES
    12  10     * I2          8 10       60       INSTACK    EXITS
    26  50     * I1         14 17      100         OPT      EXITS
```

```
      SUBROUTINE PAGEHD      74/74    OPT=1                              FTN 4.7+476        09/17/79  10.34.24        PAGE      1

    1                           SUBROUTINE PAGEHD                                                        PAGH  1
                    C     SUBROUTINE FOR NUMBERING THE PAGES AND IDENTIFYING THE RUN                     PAGH  2
                                COMMON P(9000), N(1500), TABL1(200,5), TABL2(1000,2)                     PAGH  3
                                INTEGER DAY, YEAR                                                        PAGH  4
    5                           EQUIVALENCE (N(1), IDENT), (N(8), MONTH),                                PAGH  5
                       1  (N(9), DAY), (N(10), YEAR), (N(43), NPAGE)                                     PAGH  6
                                WRITE (6,10) IDENT, MONTH, DAY, YEAR, NPAGE                              PAGH  7
                      10  FORMAT (1H1, 9X, 6HRUN NO, I6, 10X, 4HDATE, I4, 1H/, I2, 1H/,                  PAGH  8
                       1  I4, 10X, 7HPAGE NO, I6)                                                        PAGH  9
   10                           RETURN                                                                   PAGH 10
                                END                                                                      PAGH 11


        SYMBOLIC REFERENCE MAP (R=1)

 ENTRY POINTS
     1  PAGEHD

 VARIABLES       SN   TYPE            RELOCATION
 21460  DAY           INTEGER                  / /         21450  IDENT      INTEGER                / /
 21457  MONTH         INTEGER                  / /         21450  N          INTEGER      ARRAY     / /
 21530  NPAGE         INTEGER                  / /             0  P          REAL         ARRAY     / /
 24404  TABL1         REAL            ARRAY    / /         26354  TABL2      REAL         ARRAY     / /
 21461  YEAR          INTEGER                  / /

 FILE NAMES           MODE
        TAPE6         FMT

 STATEMENT LABELS
    15  10        FMT

 COMMON BLOCKS     LENGTH
        / /         13500

 STATISTICS
   PROGRAM LENGTH                  24B       20
   CM BLANK COMMON LENGTH       32274B    13500
         52000B CM USED
```

```
                 SUBROUTINE PRINTR                                       PRNT   1
C          SUBROUTINE FOR PRINTING COMPUTED DATA                         PRNT   2
                 COMMON P(9000), N(1500), TABL1(200,5), TABL2(1000,2)    PRNT   3
                 DIMENSION TIME (400), PFBT(400,15), PFT(400),           PRNT   4
     1     PF(400), PFF(400), NUMF(400)                                  PRNT   5
                 EQUIVALENCE (P(1191), TIME), (P(1591), PFBT),           PRNT   6
     1     (P(7591), PFT), (P(7991), PF), (P(8391), PFF)                 PRNT   7
                 EQUIVALENCE (N(13), NA), (N(14), NCONTP), (N(15), NP)   PRNT   8
                 EQUIVALENCE (N(45), KT), (N(49), NPAGE)                 PRNT   9
                 EQUIVALENCE (N(961), NUMF)                              PRNT  91
                 NPAGE = NPAGE + 1                                       PRNT  10
                 CALL PAGEHD                                             PRNT  11
                 RKT = KT                                                PRNT 111
                 CNT = (RKT / 55.0) + 0.99999                            PRNT 112
                 NCNT = CNT                                              PRNT 113
                 NCONT = 1                                               PRNT 114
                 NFORK = 1                                               PRNT  12
   10            WRITE (6,20)                                            PRNT  13
   20      FORMAT (/10X, 42HCONTROL POINT SINGLE FLIGHT FAILURE PROB.    PRNT  14
     1     //7X, 2HNO, 7X, 4HTIME, 7X, 4HCP 1, 7X, 4HCP 2, 7X, 4HCP 3,   PRNT  15
     2     7X, 4HCP 4, 7X, 4HCP 5, 7X, 4HCP 6 , 7X, 4HCP 7, 7X, 4HCP 8,  PRNT  16
     3     7X, 4HCP 9, 7X, 4HCP10 )                                      PRNT  17
                 IF (NFORK - 1) 360, 30, 70                              PRNT  18
   30            IF (KT - 55 * NCONT) 90, 90, 40                         PRNT  19
   40            NC1 = (NCONT - 1) * 55 + 1                              PRNT 191
                 NC2 = NCONT * 55                                        PRNT 192
                 DO   50 J = NC1, NC2                                    PRNT  20
                 IF (NP - 10) 42, 44, 44                                 PRNT  21
   42            WRITE (6,60) J, TIME(J), (PFBT(J,I), I = 1, NP)         PRNT  22
                 GO TO 50                                                PRNT  23
   44            WRITE (6,60) J, TIME(J), (PFBT(J,I), I = 1, 10)         PRNT  24
   50            CONTINUE                                                PRNT  25
   60      FORMAT (I9, 1P11E11.3)                                        PRNT  26
                 IF (NCONT - NCNT + 1) 62, 64, 64                        PRNT 265
   62            NCONT = NCONT + 1                                       PRNT 266
                 NFORK = 1                                               PRNT 267
                 NPAGE = NPAGE + 1                                       PRNT 268
                 CALL PAGEHD                                             PRNT 269
                 GO TO 10                                                PRNT 270
   64            NFORK = 2                                               PRNT 271
                 NPAGE = NPAGE + 1                                       PRNT  28
                 CALL PAGEHD                                             PRNT  29
                 GO TO 10                                                PRNT  30
   70            NC1 = NCONT * 55 + 1                                    PRNT 301
                 DO   80 J = NC1, KT                                     PRNT  31
                 IF (NP - 10) 72, 74, 74                                 PRNT  32
   72            WRITE (6,60) J, TIME(J), (PFBT(J,I), I = 1, NP)         PRNT  33
                 GO TO 80                                                PRNT  34
   74            WRITE (6,60) J, TIME(J), (PFBT(J,I), I = 1, 10)         PRNT  35
   80            CONTINUE                                                PRNT  36
                 GO TO 110                                               PRNT  37
   90            DO  100 J = 1, KT                                       PRNT  38
                 IF (NP - 10) 92, 94, 94                                 PRNT  41
   92            WRITE (6,60) J, TIME(J), (PFBT(J,I), I = 1, NP)         PRNT  42
                 GO TO 100                                               PRNT  43
   94            WRITE (6,60) J, TIME(J), (PFBT(J,I), I = 1, 10)         PRNT  44
  100            CONTINUE                                                PRNT  45
```

```
SUBROUTINE PRINTR      74/74   OPT=1                        FTN 4.7+476          09/17/79  18.34.24        PAGE     2

         110           IF (NP - 10) 212, 212, 112                                 PRNT 451
         112           NPAGE = NPAGE + 1                                          PRNT 452
                       CALL PAGEHD                                                PRNT 46
         120           NCONT = 1                                                  PRNT 461
                       NFORK = 1                                                  PRNT 47
         130           WRITE (6,140)                                              PRNT 48
         140     FORMAT (/10X, 42HCONTROL POINT SINGLE FLIGHT FAILURE PROB.       PRNT 49
             1   //7X, 2HNO, 7X, 4HTIME, 7X, 4HCP11, 7X, 4HCP12, 7X, 4HCP13,      PRNT 50
             2   7X, 4HCP14, 7X, 4HCP15, 7X, 4HCP16, 7X, 4HCP17, 7X, 4HCP18,      PRNT 51
             3   7X, 4HCP19, 7X, 4HCP20 )                                         PRNT 52
                       IF (NFORK - 1) 360, 150, 180                               PRNT 53
         150           IF (KT - 55 * NCONT) 200, 200, 160                         PRNT 54
         160           NC1 = (NCONT - 1) * 55 + 1                                 PRNT 541
                       NC2 = NCONT * 55                                           PRNT 542
                       DO  170 J = NC1, NC2                                       PRNT 55
                       IF (NP - 20) 162, 164, 164                                 PRNT 56
         162           WRITE (6,60) J, TIME(J), (PFBT(J,I), I = 11, NP)           PRNT 57
                       NFORK = 2                                                  PRNT 57
                       GO TO 170                                                  PRNT 58
         164           WRITE (6,60) J, TIME(J), (PFBT(J,I), I = 11, 20)           PRNT 59
         170           CONTINUE                                                   PRNT 60
                       IF (NCONT - NCNT + 1) 172, 174, 174                        PRNT 61
         172           NCONT = NCONT + 1                                          PRNT 611
                       NFORK = 1                                                  PRNT 612
                       NPAGE = NPAGE + 1                                          PRNT 613
                       CALL PAGEHD                                                PRNT 614
                       GO TO 130                                                  PRNT 615
         174           NFORK = 2                                                  PRNT 616
                       NPAGE = NPAGE + 1                                          PRNT 617
                       CALL PAGEHD                                                PRNT 618
                       GO TO 130                                                  PRNT 619
         180           NC1 = NCONT * 55 + 1                                       PRNT 641
                       DO  190 J = NC1, KT                                        PRNT 65
                       IF (NP - 20) 182, 184, 184                                 PRNT 66
         182           WRITE (6,60) J, TIME(J), (PFBT(J,I), I = 11, NP)           PRNT 67
                       GO TO 190                                                  PRNT 68
         184           WRITE (6,60) J, TIME(J), (PFBT(J,I), I = 11, 20)           PRNT 69
         190           CONTINUE                                                   PRNT 70
                       GO TO 220                                                  PRNT 71
         200           DO  210 J = 1, KT                                          PRNT 72
                       IF (NP - 20) 202, 204, 204                                 PRNT 73
         202           WRITE (6,60) J, TIME(J), (PFBT(J,I), I = 11, NP)           PRNT 74
                       GO TO 210                                                  PRNT 75
         204           WRITE (6,60) J, TIME(J), (PFBT(J,I), I = 11, 20)           PRNT 76
         210           CONTINUE                                                   PRNT 77
         212           IF (NCONTP - NP) 360, 215, 215                             PRNT 771
         215           NPAGE = NPAGE + 1                                          PRNT 78
                       CALL PAGEHD                                                PRNT 79
         220           NFORK = 1                                                  PRNT 80
         230           WRITE (6,240)                                              PRNT 81
         240     FORMAT (/10X, 33HSINGLE FLIGHT FAILURE PROBABILITY               PRNT 82
             1          /10X, 28HAIRCRAFT FAILURE PROBABILITY                     PRNT 83
             2          /10X, 23HEXPECTED FLEET FAILURES )                        PRNT 84
                       WRITE (6,250)                                              PRNT 85
         250     FORMAT (//7X, 2HNO, 7X, 4HTIME, 2X, 7HFLIGHTS, 5X, 6HSINGLE,     PRNT 86
             1   3X, 8HAIRCRAFT, 6X, 5HFLEET)                                     PRNT 87
                       IF (NFORK - 1) 360, 260, 300                               PRNT 88
```

```
      SUBROUTINE PRINTR     74/74   OPT=1                    FTN 4.7+476        09/17/79  18.34.24        PAGE     3

  115          260                IF (KT - 55) 320, 320, 270                         PRNT 89
               270                DO  290 J = 1, 55                                  PRNT 90
               280                WRITE (6,290) J, TIME(J), NUMF(J), PFT(J), PF(J),  PRNT 91
                       1    PFF(J)                                                   PRNT 911
               290          FORMAT (I9, 1PE11.3, I9, 1P3E11.3)                       PRNT 92
  120                             NFORK = 2                                          PRNT 93
                                  NPAGE = NPAGE + 1                                  PRNT 94
                                  CALL PAGEHD                                        PRNT 95
                                  GO TO 230                                          PRNT 96
               300                DO  310 J = 56, KT                                 PRNT 97
  125          310                WRITE (6,290) J, TIME(J), NUMF(J), PFT(J), PF(J),  PRNT 98
                       1    PFF(J)                                                   PRNT 981
                                  GO TO 340                                          PRNT 99
               320                DO  330 J = 1, KT                                  PRNT100
               330                WRITE (6,290) J, TIME(J), NUMF(J), PFT(J), PF(J),  PRNT101
  130                  1    PFF(J)                                                   PRNT1011
               340                WRITE (6,350) NA                                   PRNT102
               350          FORMAT (/10X, 8HBASED ON, I5, 2X, 8HAIRCRAFT)            PRNT103
               360                RETURN                                             PRNT104
                                  END                                                PRNT105


      SYMBOLIC REFERENCE MAP (R=1)

  ENTRY POINTS
     1  PRINTR

  VARIABLES     SN  TYPE          RELOCATION
    1074  CNT        REAL                                1103  I         INTEGER
    1102  J          INTEGER                            21524  KT        INTEGER            / /
   21450  N          INTEGER    ARRAY    / /            21464  NA        INTEGER            / /
    1075  NCNT       INTEGER                             1076  NCONT     INTEGER
   21465  NCONTP     INTEGER             / /             1100  NC1       INTEGER
    1101  NC2        INTEGER                             1077  NFORK     INTEGER
   21466  NP         INTEGER             / /            21530  NPAGE     INTEGER            / /
   23350  NUMF       INTEGER    ARRAY    / /                0  P         REAL      ARRAY    / /
   17466  PF         REAL       ARRAY    / /             3066  PFBT      REAL      ARRAY    / /
   20306  PFF        REAL       ARRAY    / /            16646  PFT       REAL      ARRAY    / /
    1073  RKT        REAL                               24404  TABL1     REAL      ARRAY    / /
   26354  TABL2      REAL       ARRAY    / /             2246  TIME      REAL      ARRAY    / /

  FILE NAMES         MODE
        TAPE6        FMT

  EXTERNALS             TYPE   ARGS
        PAGEHD                   0

  STATEMENT LABELS
      14  10                        561  20     FMT                        0  30          INACTIVE
       0  40        INACTIVE          0  42         INACTIVE              51  44
      71  50                        621  60     FMT                        0  62          INACTIVE
     103  64                        110  70                                0  72          INACTIVE
     136  74                        156  80                              161  90
       0  92        INACTIVE        205  94                              225  100
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